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CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICES—
- Eighteenth Annual Meeting, Ohio Gas Light Association..... 257
- Wrinkle Department, Western Gas Association 257

EDITORIALS—
- The Thirty-Second Meeting of the New England Association of Gas Engineers 257
- Ninth Annual Meeting, Michigan Gas Association..... 258
- Address of the President (Mr. Paul Doty, Detroit, Mich.) of the Michigan Gas Association, Delivered on the Occasion of Its Ninth Annual Meeting..... 259
- House Piping, by Mr. C. S. Griswold..... 261
- A Holder Foundation on Quicksand, by Mr. C. A. Learned..... 262
- Hints on Extending the Uses of Coal Gas, by "T. E. P."..... 263
- The Changing Use of Gas, by Mr. A. D. Adams 265
- An Analysis of the Sixth Detroit Municipal Plant Report..... 266
- Heat from Electricity, by Mr. F. O. Blackwell..... 268
- Danger of Incandescent Electric Lamps..... 268

ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 268

The United Gas Construction Company—A Calendar—Change of Ownership, Waverly, N. Y.—Contract for the Western Gas Construction Company—Annual Meeting, Syracuse, N. Y.—Mr. W. H. Frost in Charge, Delray, Mich.—Ballot Postponed—Mr. H. C. Hutchinson to Manage the Electric Division of the Cincinnati Company's Properties—The Burlington (N. J.) Company Changes Hands—Extensions at Anniston, Ala.—Change in Office Force, New London, Conn.—Brisk Work Over Office Quarters, Paterson, N. J.—Gas Output, Duluth, Minn.—Personal—Death of Mr. R. W. Gethen—Capital Stock Increased—Contract for Messrs. Bartlett, Hayward & Company—Mr. J. W. Rogers Retires from Control of the Lowell (Mass.) Company—And Many Other Items.

- The Market for Gas Securities..... 270

[OFFICIAL NOTICE.]

Eighteenth Annual Meeting, Ohio Gas Light Association.

OFFICE OF THE SECRETARY,
DELAWARE, O., Feb. 18th, 1902.

The Eighteenth Annual Meeting of the Ohio Gas Light Association will be held at Columbus, O., March 19th and 20th, 1902.

The President, Mr. Henry L. Doherty, of Denver, Col., will call the meeting to order, on Wednesday, March 19th, at 9:30 A.M., in Convention Hall at the Great Southern Hotel, the headquarters.

The Executive Committee have made a radical departure from the usual programme custom, in that no formal papers will be presented; but the following subjects will be offered for discussion, written opinions having already been submitted by several prominent men in the profession:

"Equity, Legality and Advisability of Charging Different Rates for Illuminating and Fuel Gas."
"Distribution of Gas at High Pressure."
"Future of the Gas Business."
"Is There Any Economy in a Full-Depth Bench over a Half-Depth; and Why?"
"Can Iron Meter Connections be Used to Better Advantage than Lead?"
"Are Loose-leaf Ledgers Desirable for Gas Company Records?"
"How May Complaints be best Cared for?"
"Should an Individual Pressure Regulator be Used on Every Meter?"
"Recent Developments in By-product Coke Ovens."
"Recent Developments in Inclined Retorts."
"Coke Handling."
"Isolated Generator Firing of Benches."
"Domestic Water Heaters."
"State Regulation of Quasi-public Corporations."
"The Best way to Extend Gas Mains into New Suburban Territory or New Additions; and the Best Way to Reinforce Insufficient Pressure in a Certain Section of a City."
"Wrinkle Department;" edited by Mr. E. E. Eysenbach, of Columbus, O.
"Novelty Advertising Department;" edited by Mr. B. W. Perkins, of South Bend, Ind.

The Question Box, which is always an interesting feature, will be given special consideration. Each member is requested to make contributions for this, and send them to the Secretary not later than March 8th, so that they may be printed.

An opportunity will be given all of the speakers at the meeting to correct their remarks before leaving Columbus, but not later, as all the reports will be turned over to the printers immediately after the adjournment of the meeting.

The Great Southern is conducted on the American and European ptans, and the following rates have been secured for the meeting: American plan, $2.50 to $4 per day; European plan, $1 to $2.50 per day. The Southern hopes to entertain all of the Association, and will put forth every effort to make the members comfortable. The most satisfactory quarters are always obtained by writing in advance to the hotel people.

The Secretary will furnish with pleasure application blanks for membership, and any further information which may be desired relative to the meeting.

T. C. JONES, Sec'y.

[OFFICIAL NOTICE.]

Wrinkle Department, Western Gas Association.

WESTERN GAS ASSOCIATION,
OFFICE OF WRINKLE DEPARTMENT.
BELLEVILLE, ILLS., February 12th, 1902.

This department is now open and ready for contributions, which will be presented at the Twenty-fifth Annual Meeting to be held next May. The active co-operation of all members and friends is earnestly solicited. Please forward contributions to the Editor before April 15th.

W. E. STEINWEDELL, Editor.

[Special Editorial Correspondence.]

THE THIRTY-SECOND MEETING OF THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

YOUNG'S HOTEL, BOSTON, MASS., Feb. 20, 1902.

Dear JOURNAL: The Thirty-second Meeting of the New England Association of Gas Engineers has, as its predecessors were, just been brought to a successful close, despite preliminary weather conditions that threatened the attendance from a numerical point of view. Fickle February played a hard part on Monday and Tuesday, and while its storm of snow and sleet and frost undoubtedly interfered somewhat with the attend-

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ance, particularly in respect of the delegation who would ordinarily journey from the Middle States to share in the convention, its inclemencies were not sufficient to keep the old guard at home. This means that a good attendance greeted the call to order of President Waldo A. Learned, which sound was made in the Parker House assembly room shortly after 10 A.M. of yesterday. With the celerity that is characteristic of the active man in charge of the affairs of the Newton and Watertown (Mass.) Gas Light Company (for such is Mr. Learned's everyday position), the business of the session was speedily put underway. The invitation to visitors to take active part in the proceedings having been extended (and quite a number were in attendance), the report of the Board of Directors was disposed of. The next thing to occupy the attention of the Association was the election of new members, of whom 10 active and 6 associate were placed on the rolls. The reports of Secretary and Treasurer Gifford, which disclosed a satisfactory standing both as to the office and the treasury, having been read, President Learned presented the inaugural message, Vice-President McKay meanwhile occupying the chair. I will make no comment on the address, save to say that it was a practically commonsense document, containing at least one cardinal point respecting which many of the readers of the JOURNAL will indorse. The usual reference of the address to a committee was followed by the call for "general business," under which head Mr. F. H. Shelton, Second Vice-President of the Western Gas Association, made a clever explanation of the purpose of that Association in its determination to prepare a general indexing of gas literature, the details of which matter have been given in the JOURNAL. The support that Mr. Shelton received was cordial and positive. Following this came a vote of sympathy to Capt. W. H. White (moved by Mr. Wm. McGregor, of Pawtucket, R. I.), in the instance of his sad bereavement through the death of his estimable wife. That there is brotherhood amongst gas men was again well attested by the heartiness and solemnity of the convention in this fraternal act. Roll call followed, after which the paper list was taken up. The first paper was that by Mr. George F. Goodnow, of Waukegan, Ills., whose lines were on the topic of "Distributing Artificial Gas at High Pressure in a Suburban District." In the unavoidable absence of the author the paper was read by Secretary Gifford. The discussion was notable for the championing of the high pressure plan by Mr. F. H. Shelton, who certainly has made a success up-to-date of it at least at two points. The second paper considered was that by Mr. C. S. Griswold, of Meriden, Conn., whose lines on "House Piping" brought out a discussion in which varying views were advanced. The Question Box was then invaded, two of its queries being threshed out. The next number was an extra paper by Col. F. S. Richardson, of North Adams, Mass., whose printed lines respecting "What is a Gas Company?" were well received. The Colonel owns a pretty good one in the Berkshire Hills. The morning's proceedings were brought to a close by the appointment of a committee to report suitable minutes respecting the Association's loss by death during the year. Three had joined the majority, and of the trio was Geo. B. Neal, who in his long day and time had been a tower of strength to the Association. The proceedings of the afternoon session were opened by the reading of another unlisted paper. It was presented by Mr. Thos. H. Hintze, of Lowell, Mass., who detailed the construction of "A Model Coal Shed" on the Lowell works. It led to a brisk discussion, and the tall man from Lowell should be quite well satisfied with the reception that his story received. The next topic was "The Advantages of the Card System in the Gas Ledger," whose author was Mr. A. M. Barnes, of Cambridge, Mass. Mr. Barnes was rewarded by a sharp discussion, in the course of which some of his suggestions were adversely talked about, but in the main he held his ground fairly well. The election for office bearers was then brought off, with the following result—Mr. Waldo A. Learned absolutely declined to succeed himself as President:

President.—Mr. Wm. E. McKay, Boston.

First Vice-President.—Mr. F. S. Richardson, North Adams, Mass.

Second Vice-President.—Mr. Wm. McGregor, Pawtucket, R. I.

Secretary and Treasurer.—Mr. N. W. Gifford, New Bedford, Mass.

Directors.—Messrs. W. G. Africa, Wm. H. Snow, Jos. E. Nute, Benj. Allen and Thos. H. Hintze.

Mr. McMay (perhaps I should better have written "Captain") made a very clever speech in acknowledgment of his promotion, and the man from New Bedford did almost as well. They're both good ones at the guns. Mr. C. J. R. Humphreys presented a well put together report from the committee appointed last year to consider the matter of "How Best to Sell Gas." The committee was thanked and asked to continue its investigations. Another try at the Question Box brought the proceedings of the first day to a close. A feature on the social side of the preliminaries was a dinner shared in at Young's last night by several ex-Presidents of the Association. A like tryst was held last year, but the proceedings thereat were less zealously guarded this time than then. The banquet at Young's Wednesday night was a success in every respect, over 100 sharing in its joys. Mr. Wm. McGregor was a capable toastmaster, and good and witty contributions to the flow of speech were made by Messrs. Chas. F. Prichard, of Lynn—his whiskers still are dark—Mr. Wm. McDonald, of Albany, N. Y.; and Mr. Walter R. Addicks, of Boston, whose smile is little short of healthy contagion. The second day's proceedings were opened by the considering of the paper on "Some Details in the Operation of a Lowe Water Gas Apparatus," by Mr. C. F. Leonard, of Fall River, Mass. The discussion that followed was a brisk one. The paper by Mr. A. B. Slater, Jr., of Boston, on "Coal Gas Treatment," brought out a debate which was by far the best one of the sessions. Thin though he is, Mr. Slater's arguments do not lack weight. A further try at the Question Box was followed by another extra paper, contributed by Mr. C. W. Hinman, of Charlestown, Mass., who put out in his usual lucid style an interesting set of paragraphs on "Candle Power Determination." I should have said that, prior to Mr. Hinman's paper, the one by Mr. C. A. Learned, of Meriden, Conn., entitled "Building Foundation for Steel Holder Tank on Quicksand Foundation," was read. Owing to the nature of the topics discussed there was no discusion on either the Learned or Hinman papers. Nor was there any debate on a still further additional paper, presented by Mr. George F. Macmun, of Pawtucket, R. I., on the topic of "Gas Engines." Following the report of the Memorial Committee came the usual votes of thanks, after which the meeting was declared adjourned. Messrs. McKay, Richardson and Addicks (the leading spirits on the Committee of Arrangements) deserve and have received the hearty thanks of everyone who attended the meeting, for successful and unremitting attention to their wants and needs. As we have said 31 times, we say for the 32nd time that the last New England meeting was a complete success.—S.

[Special Editorial Correspondence.]

NINTH ANNUAL MEETING, MICHIGAN GAS ASSOCIATION.

KALAMAZOO, MICH., Feb. 20, 1902.

Dear JOURNAL: The brightest of spring days greeted the members of the Michigan Gas Association, on the occasion of its Ninth Annual Meeting, which was held in this city on the 19th and 20th inst. As you know, the headquarters of the Association were in the Burdick House, and the sessions, through the courtesy of the Kalamazoo Club, were held in its handsome, commodious and comfortable assembly room. On the morning of the 19th, the meeting was called to order by the President (Mr. Paul Doty, of Detroit), who introduced Mayor Mills, of Kalamazoo. The chief official of the city extended to us a rousing welcome, and President Doty acknowledged it on our behalf in neat speech. The attendance was excellent and the interest in the proceedings never stopped. President Doty's address, which was in his usual clever style, was followed by an address by Mr. A. M. Freeman, President of the State Board of Tax Commissioners, whose explanation of the methods of the commission in assessing the gas properties in the State was at any rate sincere. The afternoon session was mainly taken up by the reading and discussion of a paper, by Mr. C. W. Tippy, of Detroit, on "The Building of a Water Gas Plant," and a statement over "The Theory of the Incandescent Mantle," by Messrs. A. H. White, H. Russell and A. F. Traver, which latter was really a report respecting the scholarship work of the Association for the past year.

On Wednesday evening the members shared in a theater party and supper, through the courtesy of the Kalamazoo Gas Company and of the General Gas Light Company, of Kalamazoo. This morning the lecture, by Prof. E. D. Campbell, of the University of Michigan, on "The Function of Original Research in a Technical Education," occupied most interestingly the time of the session. The committee in charge of the scholarship fund reported, and received ample subscriptions to continue their good work. Fourteen active and two associate members were elected, and the names of Prof. E. D. Campbell and A. H. White were placed on the honorary roll. The officers chosen were: President, Mr. J. J. Knight, of Kalamazoo; Vice-President, S. M. Dole, of Adrian; Secretary and Treasurer, H. W. Douglas. President Doty, of course, was successful and pleasing as Chairman. At the close of the meeting Mr. J. J. Knight was handed a handsome walking stick by the supply men present in appreciation of the attention paid them by giving them the use of a suitable exhibition room for their wares. The afternoon of to-day the members inspected the gas works which supply light to the State Insane Asylum. The meeting was a right good one.—D.

Address of the President (Mr. Paul Doty, Detroit, Mich.) of the Michigan Gas Association, Delivered on the Occasion of Its Ninth Annual Meeting, Kalamazoo, Mich., February, 1902.

It is with special pleasure that the Michigan Gas Association returns to meet in Kalamazoo, the place of its nativity. Nine years ago, or on March 29th, 1893, our Association was organized, and the intervening time has given opportunity to demonstrate the wisdom of the founders by the accomplishment of the objects they sought. It is human to have ideals, and of these the thought of a home-coming is always sweet. For Kalamazoo, then, we have only the kindliest greetings, and from Kalamazoo only the heartiest welcome.

Your constitution requires that "The objects of the Association shall be the promotion and advancement of knowledge, scientific and practical, in all matters relating to the construction and management of gas works, and the manufacture, distribution and consumption of gas.

"The establishment and maintenance of a spirit of fraternity between the members of the Association, by social intercourse, and by friendly exchange of information and ideas on the before mentioned subject matters.

"The inducement and extension of more cordial and friendly relations between the manufacturers of gas and their patrons based upon mutuality of interests."

It is proper, I think, on this anniversary meeting to take note of the working out of the spirit of the constitution. An examination of the list of papers written for our Association will show—following the classification of the constitution—the members who have followed the flag.

Construction of Gas Works; H. G. Beatley.
Management of Gas Works; H. G. Beatley.
Manufactnre of Gas, J. M. Calkins; E. J. Elles; John R. Lynn; Geo. Osius; B. O. Tippy.
Distribution of Gas; Paul Challis; Paul Doty; H. W. Douglas; F. H. Hess; B. O. Tippy.
Consumption of Gas; H. W. Douglas (2); Wm. M. Eaton; E. F. Gallagher; Geo. H. Harris; H. H. Hyde; J. J. Knight; L. M. Latta; Geo. D. Roper; J. C. Sloan; S. E. Wolff; A. L. Zwisler.
Relations with Consumers; Robt. Calhoun; B. C. Cobb; Sedgwick Dean, S. Milo Dole (2); Jos. Walker; L. E. Walker.
Fraternity; C. H. Raynor; H. D. Walbridge.

And, for the advancement of scientific knowledge, the scholarship paper of Herman Russell and Alfred H. White.

The constitution has been followed on all subjects save management. The opportunity is afforded to some member for the presentation of a paper to develop this subject for our next meeting. It is an American characteristic to make special effort to increase the consumption of gas, and this is reflected in the number of papers devoted to this subject. This is also true of the constant effort made by the management of gas properties to increase the cordial relations between their consumers and their companies. Consumers now get not only what they need but what they want. It is encouraging to note there are 30 separate names of paper writers; and this in a membership of but 100 men, including all grades, indicates an active, real interest in the welfare of the Association, and makes for a high standard of membership. An Association must rise or fall on its own standards, and it remains for the present and future members of the Association to maintain the present high standard. For the encouragement of the 70 per cent. of members not yet paper writers, it should be said every member is supposed to contribute his share of thought and energy toward the betterment of the gas industry, and the industry is quick to offer promotion and preferment to those who are alive to their opportunities and obligations. Let us all then take hold and lift.

A review of the year 1901 brings to mind a number of thoughts of special interest to which I invite your attention.

The general tax law of the State of Michigan is especially important, and the increased valuation of a number of the large companies has imposed an unusual burden; in some cases the taxes amount to 10 cents per 1,000 cubic feet of gas sold, a distinct hardship, and a staggering load for a company to carry. Sec. 24 of the General Law recites, "The Supervisor (or assessor) shall estimate, according to his best information and judgment, the true cash value of every parcel of real (and also personal) property, and set the same down opposite such parcel;" and Sec. 27 recites, "The words 'cash value' shall be held to mean the usual selling price at the place where the property to which the term is applied shall be at the time of assessment, being the price which could be obtained therefor at private sale and not at forced or auction sale. In determining the value the assessor shall also consider the advantages and disadvantages of location;" and, I may add, all other elements which go to make value. Location and earning capacity give value to the franchise, and while franchises as franchises are not specifically taxed, earning capacity, location, management and everything else which gives or reffects value to the bonds and stocks of the companies add to the "true cash value." I am convinced the local assessors and the State Tax Commission wish to be fair in valuations, but are determined to include our properties at their "true cash value" on their rolls, and I suggest that we determine as far as may be an equitable and logical method of informing the "best judgment" of the assessor the facts concerning "true cash values" of gas properties. A prominent banking house in New York investing largely in gas securities lays down the following rules in the purchase of gas and other properties:

1. To investigate the actual and intrinsic value of the real and personal property and the regularity of title covering same.
2. The character, scope and legality of the franchise.
3. The earning capacity of the plant.

It would seem to me that to follow these rules would be a fair way of determining the "true cash value."

The whole problem of taxation is one worth our study, and I suggest a paper on taxation for our next meeting. There is this to be said that in taxing gas companies the taxes are paid; but I hold the criterion of taxation should be benefits received and not only ability to pay.

In connection with the study of taxation, I think the time is now ripe for a Michigan Gas Commission on the lines laid down and successfully followed by the Massachusetts Commission. The subject is not one for hasty judgment, especially in Michigan, which has always held close to the principles of common law. The courts stand close to the people and the machinery of government has been the voice of the people. Commissions have heretofore not been popular, but the good work of the State Tax Commission will probably lead the way for other public service commissions. There is no question but that Michigan holds to the opinion to regulate public service corporations is its right, and that the Common Councils of cities have the continuing right to regulate not only the operation of public service corporations but the rates at which the service may be charged to patrons. A suit is now pending in the United States Supreme Court at Washington, known as the "3-cent car fare suit," between the city of Detroit and the Detroit United Railway Company, the contention being that the city has the continuing right to regulate street car fares. A similar contention in part is made by the Corporation Counsel of Detroit against the Gas Company, in an attempt to fix the rate for gas at 70 cents per 1,000 cubic feet in Detroit. I invite your consideration to regulation by State Commission *versus* Common Council. Who will volunteer to give us a paper on this subject?

The further contention is made in Detroit that the section of the ordinance of the Gas Company permitting two rates for the same gas is invalid, and as legally, therefore, there is no rate, it becomes the duty of the Common Council under the common law, having, it is claimed, the continuing right to regulate rates, to fix a reasonable rate for gas, and the Common Council, acting under the advice of the Corporation Council, passed an amendment to the Gas Company's ordinance fixing 70 cents as a reasonable price for gas for all purposes, and therefore a legal rate. The Gas Company secured a temporary restraining order from the United States District Court for Eastern Michigan, and the matter is pending the 3-cent car fare decision in Washington.

Sec. 8 of the Gas Company's ordinance passed in 1893, recites, "The said Company shall not charge nor receive any higher rate than the following for manufactured gas furnished for illuminating purposes to consumers within the city limits * * * the sum of $1.15 per 1,000 cubic feet; * * * provided, however, that any and all consumers shall at all times be entitled to and shall receive a discount of 15 cents per 1,000 cubic feet upon payment being made or tendered at any time during the month following that for which a bill is rendered.

"The said Company shall not charge nor receive a higher rate than 90 cents per 1,000 cubic feet for manufactured gas sold to consumers for fuel purposes from illuminating mains within the city limits, and every consumer shall be entitled to a discount of 10 cents per 1,000 cubic feet upon payment being made or tendered at any time during the month following that for which a bill is rendered by the said Company."

This section the Corporation Counsel contends is wrong on two counts. First, discrimination in rates for illuminating and fuel purposes; and, second, in giving a discount for prompt payment, thus discriminating between those who have ready money and those who have not.

I commend the question as to the proper equitable method of charging for gas for your consideration. A paper on "Differential versus Uniform Prices for Gas" was presented by past President Sedgwick Dean in 1900. In view of the liveliness of the subject, especially in Detroit, would it not be well to continue the subject. My opinion is that in the present state of the industry there should be no discrimination in price. If a discrimination be made it should be regarded simply as a business expedient, and whether a public service corporation legally can make business expedients or not I do not know. I do know, of course, that such discrimination has been made, and made very generally, but the fact that they have been made may or may not make them right in the eyes of the law. Custom largely governs our actions in life, and as "use is the law of language," so custom may be the law of business.

Gas for fuel is no longer an infant industry, and needs no protection, especially where fuel sales exceed lighting sales by 50 per cent. Gas for lighting is a reviving industry, and I think needs the encouragement of at least having for its price the same rate as gas for fuel. There is this to be said. The fact that gas companies were able to offer a lower price for gas for fuel was due in part to the fact that they received a higher price for gas for lighting; in other words the interest charges were carried by the lighting sales. If Detroit had not received $1 for illuminating gas it could not have sold gas for fuel at 80 cents. The time will come when 80 cents will be the uniform price. I told a reporter, who asked me why we sold gas for power at 60 cents per 1,000 cubic feet, that we could afford to sell some of our gas all of the time for 60 cents, and all of our gas some of the time for 60 cents, but we could not sell all of our gas all of the time for 60 cents. Strictly speaking if a public service corporation must give absolute regard to the equality before the law, then all of the business expedients, such as discount for prompt payment, discount for quantity consumption, or discount for nature of service, or for any other cause, must give way.

The benevolent promoter of opposition gas companies, like the poor, is always with us. To successfully meet the promoters I suggest a study of motives be made. You have heard the wish, "Oh, that mine enemy would write a book." To vanquish the promoters fight what he says in his franchise. In that which he writes and puts on record you will find his weakness. Our wish should echo, "Oh, that mine enemy would write a franchise." If a 60-cent ordinance is presented, prepare a table showing the effect of change of price upon the net earnings. I have prepared such a table for Detroit conditions. Similar tables can be prepared for other conditions. The net earnings from 60-cent gas will not interest the capitalist or honest investor in Detroit. The table presents another point of view from the standpoint of the economist. The intelligent monopolist and economist, desiring to secure the maximum net earnings, will disregard any expenses that are fixed, and will consider, first, the sales of gas demanded at various prices; and, second, the variable expenses per 1,000 cubic feet sold. The table shows $1 per 1,000 is the lowest price that yields the largest net earnings. It should be understood that local conditions must be studied and adopted to make use of the table. The example is shown to illustrate the principle.

accounts is essential to the successful management of gas properties. A manager must know how to show by reports the condition of his company. It has been said, "A man is known by the company he keeps." It should be possible to say from his reports a man is known to the company that keeps him.

An encouraging sign is the growth of interest in educational work in our industry. The American Gas Light Association's work in conducting a correspondence school is well known and favorably supported. The Western Gas Association proposes to undertake the preparation of an index to gas literature, and individually we will have pleasure in giving our financial support. The Western Gas Association is fortunate in the possession of the George Treadway Thompson foundation library for gas engineers, and such a library would increase the eflectiveness of our own educational work. The Michigan Gas Association in 1900 undertook and has successfully supported a scholarship in gas engineering at the University of Michigan. The scholarship paper in 1901, by Herman Russell and Alfred H. White, on the "Relation of Heating to Lighting Power of Gas with Special Reference to Incandescent Mantles," will be completed at this meeting, and, in addition, we are fortunate in having Professor E. D. Campbell with us to lecture on "The Function of Original Research in a Technical Education." The increasing interest in the scholarship work among the undergraduates at the University should stimulate us to hearty support. The opportunities of technically educated young men will increase with the growth and exacting requirements of our industry. You probably have read Andrew Carnegie's suggested epitaph for his tombstone, "Here lies a man who knew how to get around him men much cleverer than himself." In the same address, Mr. Carnegie disclaimed the possession of genius in his own person, and frankly gave credit for his vast achievements to the men of skill and knowledge who had aided him. Will this not be true of the great captains of the gas industry. The opportunities of education are limited only by the means at hand, and I recommend we contribute for this year from the funds of the Association not otherwise appropriated, a sum not to exceed $100, and I suggest renewed efforts be made to persuade our companies to continue to liberally support the scholarship work.

Michigan has given study to the great social problem of the day, industrial betterment. The social question, historically considered, has three phases. 1. The religious phase; 2, the political phase; and 3, the economic phase — the latter presented by the modern accumulation and concentration of wealth and the tendency toward wealth domination. It is popular to speak of the "soulless corporation" and the "greedy trust." Grand Rapids is leading the way in industrial progress in Michigan. There the Directors have established the just and generous plan of direct profit sharing with the employees. It is to the Vice-President, Mr. Emerson McMillin, that credit is due for its inception. The direct profit sharing plan put in practical operation is as follows: An employee whose wages are $50 per month will in one year draw $600. As the additional corporation returns will for the present be paid as a cash dividend, the employee will be entitled to the same dividend as a stockholder who has $600 invested. The dividends declared by the Company in the recent past have been 3 per cent. on the stock, payable semi-annually; the cash dividend received by the employee will, therefore, be $18 semi-annually. The same rate of dividend applies to all grades of service for the employees, and for the numerous and varied rates of wages. All alike share equally, the basis of the amount of the dividend being the amount of the earnings of the individual employee. For the purposes of record, and for the inspiration of other boards of directors, I insert a copy of the resolutions adopted by the Grand Rapids Directors.

Table Showing the Effect of Change of Price Upon the Net Earnings.

Proposed capital, $2,500,000. Total population, 300,000. Gas consuming population, 250,000.

Price.	Sales per Meter.	Meters to Population per Cent.	*Earnings pr. Meter.	Total Meters.	Total Sales.	Gross Earnings.	50c. Variable Operating Expenses.	Fixed Operating Expenses.	Total Operating Expenses.	Net Earnings.	Interest on $2,500,000 at 5 per Cent.	Surplus Profit Available for Dividends.
$1.60	20,000	6	$32	15,000	300,000,000	$480,000	$150,000	$140,000	$290,000	$190,000	$125,000	$65,000
1.28	25,000	7	32	17,500	437,500,000	550,000	218,750	140,000	358,750	191,250	125,000	66,250
1.06⅔	30,000	8	32	20,000	600,000,000	640,000	300,000	140,000	440,000	200,000	125,000	75,000
1.00	32,000	8.5	32	21,250	680,000,000	680,000	340,000	140,000	480,000	200,000	125,000	75,000
.91⅔	35,000	9	32	22,500	787,500,000	720,000	393,750	140,000	533,750	186,250	125,000	61,250
.80	40,000	10	32	25,000	1,000,000,000	800,000	500,000	140,000	640,000	160,000	125,000	35,000
.60	53,333⅓	10.5	32	26,250	1,400,000,000	840,000	700,000	140,000	840,000	....	125,000	125,000 deficit

* See Presidential Address of Mr. Chas. H. Nettleton, before the American Gas Light Association, Oct., 1897.—Vol. XIV. Proceedings, p. 62.

Publicity, more publicity, and still more publicity to corporate affairs is the cry to-day. There is a desire on the part of the public to regulate public service corporations or companies operating under municipal franchises, and a correct statement of the accounts of the company appears to be the most practical form of regulation. A gas commission would naturally require prescribed forms of accounts, and it should be to our interest to present suggested forms. Our sister Associations are giving study to the subject of uniform accounts for gas companies, and Michigan should co-operate, if need be. The ability to analyze gas

"*Whereas*, It is the opinion of this Board that continuous and faithful service on the part of the officers, agents and employees of the Grand Rapids Gas Light Company merits substantial recognition by the directors. Now, therefore, be it

"*Resolved*, That, with the intent of rewarding continuous and faithful service on the part of the employees of this Company, hereafter and until further ordered by the Board, on the dates when dividends are declared payable to the stockholders of the Company, there shall also be ordered paid to the employees of this Company additional compensation, the amount of which in each instance shall be ascertained by multiplying the total sum of each employee's wages during the preceding half fiscal year by the same decimal figures that are used in arriving at the amount of dividend to be paid to each stockholder. The character and kind of such additional compensation, when, how and to whom it will be given, shall be governed by the conditions hereinafter recited.

"*Resolved*, Second, that to entitle any officer, agent or employee of the Grand Rapids Gas Light Company to receive additional compensation for meritorious services the following conditions must obtain in each instance:

"1. The employee must have been in the continuous employ of the Grand Rapids Gas Light Company for 1 year preceding the beginning of the half year for which extra compensation may be awarded.

"2. Should an employee quit of his own motion, or be discharged for cause from the service of the Company, he shall not be entitled to the extra award for the fraction of the half year.

"3. The extra compensation is purely voluntary on the part of the Company, and may be discontinued at the pleasure of the Board.

"4. The Board may, at its pleasure, increase or decrease the amount of the extra award, and may at will change the kind or character of the extra compensation."

Grand Rapids has gone farther, and given in addition to profit sharing prosperity sharing. It has provided washrooms and lockers at the works, rest and reading rooms for the young ladies at the office, Saturday half holidays in the summer, minimum Sunday labor, a New Year's Eve supper, entertainment and dance. The young ladies are given an extra hour Saturday noons for shopping to avoid being on the streets Saturday evenings, many of them being self supporting. Flower gardens are kept at the works, and many other evidences of thoughtfulness are made. A system of old age pensions was established whereby an employee who wished to retire was given monthly an amount equivalent to 1 per cent. of his average yearly wages for the past 10 years for each year of continuous service. For example, suppose that the average yearly wages for the 10 years previous to retirement is $600, and the employee had been 30 years in the service, he would be entitled to 30 per cent. of $600, or $180, or a pension of $15 per month.

There is a "League for Social Service," having its head office at 105 East 22nd street, New York, Dr. Wm. H. Tolman, Secretary, which publishes a monthly paper, "Social Service," and has on record the various movements for industrial betterment. Commercial membership in this League costs $25 a year, and I recommend membership for those companies interested. I met Dr. Tolman in Detroit recently, and he remarked that "There surely was hope for the success of the movement when a gas company would pay its good $25 to learn of social progress." I think the remark unfair, but it perhaps illustrates the necessity of gas companies setting themselves right in the public mind.

The development of business can be studied in Census Bulletin No. 123, dated January 3d, 1902, and published by the Census Bureau at Washington. The sales of gas in Michigan for 1900 are reported to be 1,127,095,479 cubic feet, the value of which is $1,224,724, and the average price $1.087. I have reason to believe the total sales of manufactured gas in Michigan for 1901 exceed these figures by 30 per cent.

The technical side of the industry is not without interest. There was erected at Detroit an entirely new water gas plant, having a capacity of 2,500,000 cubic feet daily, and of which a description will be given to you in the paper by Mr. C. W. Tippy, Asst. Supt. of Manufacture at Detroit. A battery of 30 Semet-Solvay coke ovens was erected and put in use at Delray near Detroit. Thirty more ovens will be erected this year at Delray.

The principal use of these ovens now is the manufacture of coke. It is reported that 15 Otto-Hoffman ovens will be erected this year at Wyandotte. This development of the coke oven industry will be watched with interest by the manufacturers and distributers of commercial gas. High pressure distribution is being successfully carried out in Detroit, especially to outlying territory, to avoid district holders and expensive main construction. The calorimeter is being employed more generally as an aid to determine the price of gas. The analysis of the heating value of gas is quite as important as the observation of candle power. The failure of the supply of natural gas from the Canadian fields was a severe blow to Detroit industries. No natural gas is now being exported to Detroit. Whether the explorations undertaken for the discovery of gas in the Trenton strata at Kingsville, Ont., will be successful or not is unknown. The visitors to the Pan-American Exposition at Buffalo, N. Y., could not but be encouraged by the numerous exhibits of gas engines. Gas for power is the infant industry for us to-day to be encouraged by concession in price, if such concessions can legally be made.

The awful tragedy at the Pan-American, in the death of a good, and beloved President, was a heart blow to every loyal American. It is our privilege as citizens to offer our support to the memorial to William McKinley, President and man, and I know what we give we give gladly.

The year 1901 with its hopes is now but a memory. The deeds we have done are on the record, and will be the inspiration for greater success in 1902.

For myself I thank you for the honor of being your President, and I am grateful for your loyal support. I have found a year in Michigan is not without its experiences.

House Piping.

[A paper read by Mr. C. S. Griswold, of Meriden, Conn., at the Thirty-second meeting of the New England Association of Gas Engineers.]

In the spring of 1899 we put in execution a plan we had for the piping of houses situated along the line of our main in which gas had never been used for lighting. The introduction of gas stoves, with one light over the stove, has caused the people to inquire the cost of piping their houses, but in many instances the expense was so great it seemed to them exorbitant. These houses were in most cases owned and occupied by mechanics whose only income was their daily pay. After conferring with the local gasfitters, we established a price for both concealed and exposed piping, with fixtures and globes complete, ready to light, with stove connection (where one was not already in), for $11 and $15 respectively, for 4 rooms, every additional room being $2 extra. We also gave a price without fixtures. We contracted with a local firm which manufactures gas fixtures to supply what was needed. They designed one especially for us. We carry but two styles and prices of fixtures.

During that year we piped 128 houses, the local fitters doing most of the work, at $2.50 an opening, concealed piping. This was done without any canvassing other than the distribution of circulars and newspaper advertising.

At the close of the season the gasfitters thought there was not money enough in it for them, as the price of pipe had advanced. We, therefore, concluded to do our own piping, employing the men who had been setting stoves for that purpose. The plan of doing our own work gave better satisfaction, both to the consumer and to the Company, more especially to the consumer, for in many instances one might wish a slight change from the original order, which can be made by the Company at a nominal cost; and it more than pays, for it pleases a customer. In all cases trying to please a customer pays, for it brings new business and is a cheap way to advertise. To do this no large outlay is necessary, but careful attention to smaller details will usually accomplish it.

During the year 1900 we continued the same plan, but raised the price to $13 for our A grade, and $18 for our B grade of fixtures for 4 rooms. That year we piped 142 houses and also furnished quite a number of fixtures to houses already piped.

In 1901 we changed the style of fixtures, but only carried two styles and prices as before. For the year we have piped 109 houses.

The houses piped are usually from 5 to 10 rooms. Only the very best black pipe is used, and galvanized fittings. Our fitters are of the best, and some of them have been in our employ 5 years. Some who came to us as helpers are the best fitters we now have. They have been taught to think and work quickly, to use as little pipe and as few fittings as practicable, and have the work well done. In my experience as inspector of gas piping I find that gasfitters in general use too much gas pipe and too many fittings. Another difference between our fitters and regular plumbers is in the *use* of fittings. They use L's where they can; we use T's, for the reason if changes were to be made they could be accomplished more easily and much cheaper than when a line has to be cut to insert a T. Another advantage is, if from any cause there is a

stoppage in the pipe you can more readily and with less expense remove the obstruction.

The sizes of pipe are mostly ¾ inch, ½ inch, ⅜ inch. Risers are never less than ¾ inch; stove lines ¾ inch; house runs usually ¾ inch; if not very long, ½ inch; never but one opening off ⅜ inch. The reason galvanized fittings are used is there is less liability for sandholes than with black fittings.

The fitters must be courteous, quiet, quick and neat, quiet about the house, quick to think and work, and neat about their work. One who is used to piping will always try to get his riser so that he can extend from it with as few angles and as few cuts in the floor as possible. Of course, some houses are harder to pipe than others. Those with double floors, or floors deadened with cement (our price is $3 extra for such), make a slight difference, but less than many would think. Gas pipe is small and takes up but little room.

Some people have said, "I should think the local plumbers would be down on you." Not necessarily; they could not get this work, or very little of it, for they cannot afford to do it as cheap as the gas company, and as the gas company does not do any new work, there is no conflict between us. We are on the best of terms.

The net loss per installation, when plumbers were doing the piping, was $6, but now that our men do the work and have become more experienced the loss is practically nothing.

This year we expect to introduce a new plan. We will set a stove, with one light over it as usual, and pipe (exposed piping) for two additional lights, either side bracket or single pendant, at an estimated cost to us of $15. To collect this amount we propose to set the slot meter at a sufficient advance to enable us to get returns in 5 years, at which time the outfit belongs to the consumer. This will give us the opportunity of reaching a class of customers never before obtained.

A Holder Foundation on Quicksand.

[A paper read by Mr. C. A. Learned, Supt. Meriden (Conn.) Gas Light Company, at the Thirty-second Meeting of the New England Association of Gas Engineers.]

When in the course of events it becomes necessary for a gas company to provide extra storage capacity for its increasing business, it is seldom that it has a choice of sites beyond its own generating plant; and that choice is an all important matter. Adjoining the works is a piece of meadow land, 300 by 500 feet, recently acquired by the Company, on which it was decided to erect a new holder.

Meriden lies in a valley between high hills. There are three peaks to the west of the city, one of which rises 1,000 feet high, and from which most of the central and southern part of Connecticut can be seen. This spot is the highest ground between Maine and Florida, within 50 miles of the coast.

In the valley, which is claimed by some to be the original bed of the Connecticut river, is a soil which does not materially differ from one end of the town to the other, and consists of a sandy loam, a little gravel and plenty of quicksand. Most of the buildings in this valley rest on the skin which is found at various depths below the surface.

Holes dug in the meadow above referred to revealed the fact that we were in the center of the quicksand district. Careful borings were made over a section, 120 feet wide by 250 feet long, to determine the thickness of the gravel, if any, and its distance below the surface. To the west of this section, and 25 feet distant, runs a shallow brook, 20 to 30 feet wide —shallow except in freshet time.

About 75 tests were taken, and the results laid out and plotted into curves so that we might locate the most desirable place for the site. The top material was a sandy loam, evidently a silt deposited from the overflow of the brook, when in past years it was not so confined; the next a good gravel, but very thin; below that a quicksand of unknown depth.

At a few points the gravel was found as near as 2 feet from the surface and 2 feet thick, while at the others it was 8.5 deep and only .4 thick, shading off to nothing. The average depth, however, taken from the boring stations, was 5.5 feet deep and 1.2 feet thick. A boring of 50 feet taken in the center of the site showed 42 feet of quicksand and still more below.

On such materials it was decided to construct the foundation and erect a steel tank holder, to be 115 feet in diameter and 103 feet high, holding 700,000 feet of gas in 3 lifts. The weight of the holder to be 475 tons, and the weight of the water to be 8,625 tons, or a total of 9,100 tons.

Borings were commenced as soon as the frost was out of the ground, and excavating was begun as soon as it was determined which was the best location.

As the work of excavating progressed and the gravel was exposed, there was found a clearly defined depression diagonally across the pit, as if at some time the brook had flowed through that way; for logs and trunks of trees were found together with a quantity of brush. Through this depression the gravel was very thin, and in three places the quicksand was entirely exposed—the first, a space 10 by 15 feet; the second, a space 4 by 12 feet; the third, a space 3 by 15 feet. This was depressing indeed.

Hardly had the whole of the loam been removed when a rain came, followed by a heavy freshet, overflowing the meadow and deluging the pit. When the water had subsided energetic means were taken to get it out as quickly as possible. It was pumped out in 8 hours with a 4-inch centrifugal pump and a 7½-horse power motor, though the water was 10 feet deep in some places.

The freshet convinced us more than ever that in erecting a holder it would be advisable to make the top of the foundation above high water mark, which in this case would mean a fill in some spots of 12 feet, with an average of 8 feet, and the steel tank would be 2.5 feet above the level of the meadow.

At this point a difficult problem was confronted. As previously stated, Meriden topographically is on high hills and in a sandy valley; good gravel is a very scarce article. Four miles away, on the line of the railroad, is a large, poor gravel bank, and 2 miles in another direction is another small, good bank; but with all the teams that could be procured it was not possible to haul the material as fast as it was needed; and it was expensive—$1 per yard, delivered. It was evident that other and good material must be obtained in large quantities.

On the line of the railroad 3 miles away is a large trap-rock quarry, with which the New York, New Haven and Hartford Railroad is ballasted. Refuse, in the shape of iron-stone, soft rock and some dirt, is accumulated in large quantities. It was believed this stone would mix well with the material which was on hand and could be purchased, after it had been passed through the crusher to a 1½-inch size. This could be purchased at 60 cents per yard delivered on the works' siding, and in quantities up to 150 yards per day. About 50 yards of gravel and 50 yards of clean, sharp sand could also be procured each day, and as much ashes from the works as there were teams to put on it.

The question of piling was considered, and by some might seem the only wise plan under the circumstances, but after consulting our largest local builder, who had worked on this quicksand for 30 years, and had erected some very heavy factory buildings on it, it was thought best to put in a combination filling of the above named materials. As stated previously, the average gravel thickness was 1.2 feet. The color of the whole soil is that reddish brown stone color so common in Connecticut; Portland, 10 miles away, being the center of the district where the best brown stone is quarried.

The quicksand is found hard packed and not easily dug, unless water is allowed to mix freely with it. Although the excavation was in places much below the level of the brook little water was encountered, and quite as much came from the land as from the brook side. By keeping the bare spots well drained the men could work upon the quicksand with a degree of ease without sinking in very deep; the less it was disturbed, however, the better off they were. Over these bare spots it was decided to lay plank close together lengthways of the holes, and upon these 8-inch by 10-inch timbers, 8 inches apart, crossways of the holes. The filling between the timbers was of pieces of bricks and old retorts broken up fine, that being the best material at hand just then. One of the bare spots being narrow and long, the surface was covered with large flat stones, the smaller spaces being filled in with fine bricks and coarse ashes.

While working at this low level a pump was run night and day; also, from these quicksand spots a 4-inch tile drain was laid to a central point to facilitate drainage and keep the mass from becoming spongy while the tamping was going on and each course of filling was laid.

Until the whole surface approached a level no roller could be used, but everything put in was thoroughly rammed and sprinkled. The layers were about 3 inches thick over the whole surface. When the valleys were evened up a 2-horse, 4,000-pound roller was put on, and as the thickness became greater this roller was increased in weight to 6,500 pounds, requiring 4 horses. When the level of filling had been raised above the natural water level the pumping was dispensed with over night, allowing the foundation to be saturated, but it was pumped out again in the morning.

Near the center of the foundation a loose brick well was built up, into which the water ran as the foundation was successively wetted, and from which it was pumped to the brook. There were some high knolls of gravel not over 3 feet under the surface. It was thought at

first that the 5-foot concrete side wall foundation might rest on these, but further consideration convinced us that this was not advisable, as part of the foundation would rest on natural gravel while most of it would be on filled ground, so the whole level was raised 1 foot, to allow of the same kind of cushion underneath the whole structure, before the 5-foot circle was started.

The layers spread each day over a diameter of 125 feet were about as follows: 125 yards of quarry refuse; 40 yards of good gravel; 50 yards of works' ashes.

Towards the end of the work the ashes were exhausted. Near by was a bank of 500 yards of sand, and from this was taken what was needed to make the top dressing under the concrete, spreading on the stone, washing it in and carefully rolling. Toward the end the roller worked night and day.

Near the edge where the wall of concrete was laid there was a space that could not be rolled, but had to be filled and tamped to a depth of 4 feet. In order to make sure that this portion was as solid as the center, a round tapering bar, 5 feet long, was driven into the main foundation several times. Seventy blows on the average were required to drive it 4.5 feet, and the outside ring was tamped until it equalled the above test.

The amount of material removed approximated 2,900 yards. The work of excavating and filling ready to begin concreting took 22 days, and 6 days more were required to fill in around the great circle after the concrete wall was 4 feet high. This, however, did not delay the concreters in their work.

The filling was as per the following amounts:

Quarry stone or refuse	1,780	yards.
Gravel	680	"
Sand	310	"
Ashes	1,100	"
Total	3,870	"

Upon this foundation was laid 630 yards of Portland cement concrete, in the following proportions: 1 of cement, 2½ of sand, and 5 of stone. The size of stone was 1¼-inch, and smaller. A great circle of concrete, 4 feet wide and 1 foot thick, was laid 5 feet below the finished top. On this circle was laid a ring, 3 feet wide at the bottom, tapering to 2 feet 9 inches wide at the top, and 3 feet high; resting upon the ring was laid, over the whole diameter of 118 feet, a layer 1 foot thick, trued to perfect level and plastered smooth.

This work was accomplished in 18 days and in a most satisfactory manner, a local engineer taking the job at $4.90 per cubic yard laid. As soon as the foundation was ready the iron men were on the ground, and the holder was erected, complete, in a week less than the specified time of 4 months.

In order to prevent the action of the brook eating away the bank near the holder, a stone wall 7 feet high was built to the level of the top of the holder foundation and 400 feet long, protecting also a new purifier building near the brook. City water was used to fill the tank, as the brook water contained acids. It took 3½ days to fill the tank, which holds a little over 2,000,000 gallons. Before the water was put in careful levels were taken on 8 points of the foundation. After filling, levels were again taken and there was not the slightest settlement.

Hints on Extending the Uses of Coal Gas.

By "T. E. P.," in *Gas World.*

The subject of new or extended fields for coal gas is necessarily one of much interest to the industry, and more especially in those districts where electrical competition is most keenly felt. The present article is based upon the experiences of the writer in connection with the introduction of gas as a heating agent in trade and factory processes. There are here possibilities for very important developments, and—in manufacturing centers—for large increases in gas consumption. The same remark applies, only to a more limited extent, to the employment of gas in motive power, as here, too, there are certain unexplored but very important fields.

Difficulties to be Met.—With reference to the introduction of gas for trade work, drying, metal melting, heating, annealing, etc., there are, of course, difficulties to be contended with. These may be summarized as follows: (1) A rooted antagonism on the part of the average manufacturer towards change of any sort; (2), a change having been made, the usual endeavor to run the new fuel as much as possible on the old lines; (3), ignorant experimenting, regardless of all laws governing the flow and combustion of illuminating gas; (4), general misconceptions as to cost of gas in comparison with solid fuel, and a total disregard of the reduced waste of raw material incident to the introduction and use of gaseous fuel; (5), generally a limited practical experience of gas utilizing appliances in trade work. To know and recognize these difficulties should simply be a preliminary to meeting and surmounting them.

The conservative objections of the manufacturers are best met, whenever possible, by a reference to a user of apparatus similar to that in contemplation. As a rule, practical demonstration of this nature amply suffices, and the prospective customer is convinced of the advantages to be derived by supplanting his coal furnaces by well regulated gas furnaces. The second point is more difficult to deal with. Old traditions are hard to kill, and often cling even when an enterprising policy has been adopted. These may result in seriously hampering the new fuel, by causing it to be worked under old established lines and conditions entirely unsuited to it, and which must be fatal to its success. To obviate, this, the gas manager must watch very jealously any changes in his district from solid fuel to coal gas, in order to insure that the requirements of efficient combustion are well provided for. He must bear in mind, too, and impress upon his customer, that in most instances gas furnaces are capable of turning out, according to circumstances, from twice to four times as much work per diem as the furnaces which they displace. Economical considerations alone would suggest the necessity, in such cases, of more or less re-adjusting the old working conditions.

Well-Meaning but Ignorant Experimenters.—The third matter referred to is dealt with similarly. Perhaps nothing else has brought such discredit upon coal gas in this connection as the efforts of well-meaning but ignorant experimenters who, knowing little or nothing of the laws governing either the flow or the combustion of illuminating gases, construct furnaces for various purposes which are, as they are bound to be, absolute failures, and bring contumely, not upon their ignorant designer, but upon the gas manager and his "useless gas." It is, of course, essential to success that these appliances be built on scientific lines, and be designed, first: To develop the highest heating efficiency from the gas employed, consistently with the conditions of the work; and second, to so adapt the heat generally to the work as to secure as fully as possible its full utility. These are matters that cannot be dealt with by a tyro, and the gas manager will be well advised to courteously yet firmly insist upon matters beyond his own ken being referred to a reliable expert.

As to the cost of gas fuel. When required for intermittent use, and if the furnaces or appliances do not require much gas for "heating up," the gas fuel will in many instances be found very much cheaper than solid fuel. Where the furnaces themselves absorb much heat, this will be an important consideration as regards their intermittent use for only limited periods of time, although, of course, the same conditions obtain where solid fuel is used. Even for continuous use, coal gas for many purposes comes out cheaper than coal, wood, charcoal, or coke, owing to the better facilities which it affords for controlling, adapting, and utilizing the heat. Nor is this matter so affected by purely local considerations as might be expected.

Practical Illustrations.—The fact is that differences in prices, either of solid or gaseous fuel, amounting to 15 or 20 per cent. increase or decrease, may possibly not affect the financial results of working to the least appreciable extent. A case just stated to the writer will illustrate this. A South London manufacturer was explaining why it would pay him better to run a machine by gas which, for fuel alone, would cost twice as much on the turnover as under the old process. It appears that the loss of raw material incident to the working under the old treatment sometimes amounts to a figure considerably in excess of the total amount of the fuel account. It is anticipated that by the use of a gas furnace the whole of this waste of raw material will be entirely obviated. Precisely the same conditions obtained in a drying apparatus put in, upon the writer's initiative, some years ago in a North London factory. There the manufacturer was peculiarly liable to accidental waste of very valuable material, representing a considerable pecuniary loss. With the gas appliance now in use not a yard of that material need be wasted. These are not isolated but general experiences of firms who substitute well controlled gas furnaces, suited to the work in hand, for the old type of furnaces burning solid fuel.

Another consideration already touched on is of paramount importance. This is the swiftness with which the work can be done. Take, for instance, a series of metal melting furnaces. Many of these furnaces are preferably of such limited capacity that their contents can be handled by one or, say, two men. The old furnaces, by dint of close attention, may deal with, say, four charges of metal per day. A series of gas furnaces, taking the same weight of metal per charge, will pro-

bably turn out not less than 8 to 10 charges per day. Thus, the same floor space of works, practically the same plant and the same workmen, will, with a small increase of labor and fuel, become capable of a production equal to twice to three times that of the old style of furnaces. This question of cost of fuel must, therefore, be considered in conjunction with other considerations, such as the prevention of waste of raw material, greater output from the same space and with the same productive plant and labor, fuller control, and enhanced cleanliness and healthiness.

The Use of the Expert.—The fifth point named does not apply only to the general public; it is more or less true as regards the majority of gas managers. Nor does such a statement cast any reflection on the latter. The duties of his office are so arduous and responsible, taxing both time and energies to the utmost, that the manager is not, as a rule, able to secure many opportunities of becoming practically acquainted with developments outside the sphere of his own operations. Moreover, the business under review is one that necessarily covers almost every conceivable trade or industry; and the successful designer of plant for use in trade processes must needs be conversant with the details and general conditions obtaining in the particular trade or process for which the plant is required. Such an all round knowledge cannot reasonably be looked for amongst men whose ordinary daily duties are such as to absorb both time and energies to the utmost.

Hence it is that, whilst keeping in touch with all such matters, as far as time and trade journals, etc., will allow, the gas manager will often find it the simplest and best plan to refer inquiries, or possible requirements, for plant outside the sphere of his own ken, to those who make it their life business to study such matters, taking every precaution that—in the reference of the particular inquiry in hand—every detail and circumstance which may have more or less bearing on the successful working shall as far as possible be noted and reported upon along with the inquiry. There are several good and reliable firms in this country whose experience justifies confidence, and to whose courtesy in studying the customer's requirements and in submitting suitable proposals the writer can with pleasure testify; and a fairly large connection in the business under review has convinced him that the interests of the gas undertaking will, as a rule, be best served by adopting the course here recommended.

The Scope of the Business.—The scope of the business can, perhaps, best be estimated by a glance through the catalogues of such firms as deal in gas utilizing plant. Some of these lists are very comprehensive, and include items very interesting. Thus, in metal tempering plant, we find a series of automatic feed machines for hardening steel cones of bicycles, or similar small work, by which the pieces are automatically taken up, passed into the machine, raised to the required temperature, and then discharged into the cooling chamber. Another equally interesting contrivance deals similarly, and in bulk, with bicycle balls, saw teeth, pens, nuts, bolts, screws and other small work, which is passed through the apparatus and delivered therefrom, finished to any degree of hardness, in quantities varying from 1,500 to 2,000 pounds of steel per day, according to the class of work in hand. In the same list will be found particulars of machinery for similarly dealing with the edges of mower blades, or smaller blade work; also smaller machines for tempering needles, springs, etc. The gas consumption given for the plant just referred to varies from 100 to 300 cubic feet per hour. In addition to this there is, of course, the power requisite for driving the machinery, also for providing the necessary air blast, all of which provides further opening for gas consumption, and the whole of which, including the furnace, suffices to assist in very respectably increasing the gas manager's output returns.

A somewhat higher gas consumption (about 350 cubic feet per hour) is the requirement of another type of furnace—for annealing purposes. This displaces charcoal, and although the gas consumption is heavy the fuel charges will be decreased by the change, owing to the fact that the charcoal fires have to be kept going continuously for intermittent work, whereas this condition does not necessarily obtain with the gas furnace, which need only be under fire for a very short time beyond the requirements for actual work. An interesting furnace the writer recently saw at work, being used for rivet heating, is one for which in many manufacturing districts there should be a good demand. With modifications it could be made portable and thus become a useful adjunct in boiler repairs *in situ*, as well as in general workshop practice amongst iron workers and boiler makers. It is used with an air blast. The floor slopes towards the front, where a removable block serves as a door, whence the heated pieces are removed, the latter being fed into the furnace at the back end and from the top. This furnace is suitable for heating small work, hardening dies, etc.

Some Furnaces.—Of annealing furnaces there are, of course, a great variety, large and small, already in use. They are built up for working with or without blast, according to circumstances. In the case referred to above it is necessary to fully protect the metal under treatment from direct flame contact and, more especially, from the products of combustion. An inner annealing pot is therefore provided. In annealing work this is a condition that often must of necessity be imposed. In some patterns it is provided for in the manner just noted, and in others the furnace is divided by a horizontal slab, underneath which is the combustion chamber, the upper section forming the annealing chamber. As such a provision necessitates a heavier gas consumption than where direct flame contact is permissible, furnaces embodying the latter principle will, of course, be used wherever the materials under treatment or the conditions obtaining will allow.

Of crucible furnaces, and the very comprehensive range of muffle and reverberatory furnaces, originally designed and introduced in this country by Mr. Thomas Fletcher, F.C.S., it is unnecessary to write at length. Suffice it now to point out that in these furnaces the gas manager has, ready at hand, tried and proved apparatus that could well be introduced to numbers of his manufacturing customers now using coal or other solid fuel, and who, unless better advised, will continue to do so. Inasmuch as those most interested in effecting a change are the gas suppliers, it is not unreasonable to expect the initial effort to emanate from them.

A lead hardening furnace recently described to the writer is worth special mention. This is a crucible furnace for hardening steel work, the crucible holding some 100 pounds or so of lead. The novel feature of the furnace is the arrangement of the burners, one on either side, so that the flames are tangential to the crucible, and are thus given a rotary motion about it. The destructive effect of the flames impigning direct upon the crucible is in this way entirely obviated. The gas consumption is given at from 80 to 100 cubic feet per hour.

Another furnace, similarly heated, and embodying the "down draught" principle, is used for melting silver, copper, brass, steel or iron. In this furnace also the burner is tangential to the crucible and is given a slightly downward inclination. The flame is thus injected into the air space between the crucible and the outer lining, whilst the pressure behind it secures its rapid rotation downwards around the crucible. The exhausted flame and products of combustion pass from the furnace through a chamber underneath the crucible into an outlet flue. This type of furnace is constructed to receive crucibles holding from 100 pounds to 500 pounds of metal, and the gas consumption is given at from 300 to 500 cubic feet per hour for the range of sizes just noted.

A Furnace Wanted.—But it certainly appears to the writer that the gas furnace for melting large quantities of metal economically as regards gas consumption has yet to be invented. The crucibles are themselves a source of very considerable expense, especially as regards the larger sizes. In addition to this, they necessarily absorb a great amount of heat, representing a much greater gas consumption than theoretically would be required simply for reducing the metal to a molten condition. Experiments are, and have for some time been, in progress with a view to meeting this want; and the manufacturer who will first produce a furnace heated by coal gas which will—with a gas consumption costing not a great deal more than the present cost of solid fuel—satisfactorily melt copper, bronze and other like metals in lots of from 60 pounds upwards, without the use of a crucible and without any destructive action on the metal itself, will find a good and ready market awaiting him. Up to the present the cost of melting by means of gas, from the fuel consumption point of view, seems to be about double that of solid fuel. Against this can be set many important advantages which, however valuable, do not necessarily compensate. If the work can be done more economically, and especially if crucibles can be dispensed with, there will be a good future for the appliance.

Of the multitude of blowpipes, tool heaters and other of the well known small workshop appliances—all of which can be looked upon by the gas manager as dividend earning machines for his undertaking—it is unnecessary to speak, further than once more to call attention to their important possibilities in the connection now under review.

Gas Engines.—Although, chiefly through the enterprise of manufacturers, gas engines have of late years come very much into evidence, there is yet, especially in the smaller provincial towns, good scope for the gas manager to popularize their use by seeking out and improving every possible opportunity. There are in the country thousands of small manufacturing tradesmen employing hand machines who should not be difficult to convince of the advantages attending the use of a small gas engine. Let them see that against the extra charge for gas there will be

the release of a far more expensive item for labor; also that the continuous work of the engine may be equal to a turn-out of possibly three times as much work as from the old hand machines. The change must thus, in many instances, be truly a very profitable one for the customer. A very general difficulty is, of course, the first cost of the engine. But surely no important gas undertaking is in such a position as to be unable to render very practical assistance. Moreover, the engine makers are, as a rule, ready to meet, as far as possible, the convenience of their customers. It may be as well to note here that the position of engine makers is different from that of gas burner and furnace makers, inasmuch as there is necessarily much more profit in the sale of an engine than in that of a $3.75 blowpipe; although in all probability the gas consumption (and consequently the interest of the gas undertaking) will be far greater from the blowpipe.

Dynamos and Motors.—There is one direction in which these engines may be employed which certainly has had but scant attention from the gas industry. This is for driving dynamos for generating consumers' own electric current. The Long Eaton Gas Company have shown good enterprise in this connection. Accepting the fact that some of their customers are determined to have electric lighting and electric motors in their mills, they have secured parliamentary powers, not only for hiring out gas engines, but also for supplying dynamos and motors to their customers. Without necessarily going as far as this, all gas managers will do well to realize the competitive attractions of the electric light, and the fact that its seductions will wile away many of their best customers; also that there are conditions under which a system of distributed electrical motors meets customers' requirements better and more cheaply than central power and distributing shafting with belts and pulleys; and, realizing these facts, to do all that can be done to meet the wishes and requirements of customers. In this they have a very powerful ally in the fact that it is much cheaper to generate current locally, say from a gas engine and dynamo, than to pay the supply company's charges (including the heavy cost of distribution). With gas at 75 cents, it ought to be possible to produce current at an inclusive rate of 6 cents per unit, as against the 12 cents charged by the supply company. The gas consumption, per unit of electricity generated, will cost from 2 to 3 cents, according to price of gas and efficiency of plant. An installation the writer recently inspected was taking about 8 kilowatts of current per hour for a number of arc and incandescent lamps. The gas consumption for the engine came out at exactly 2½ cents per B.T.U. That installation was costing only, at the outside, 5 cents per unit for lighting, as against 12 cents charged by the local electric supply undertaking.

The comparison does not hold good where electricity is supplied at the low rates charged for motors. This does not apply, however, to current used for lighting. It is supplied at a day rate. But even the power rates favor the gas engine, which, at the lowest efficiency, should yield a brake horse power per 2 cents' worth of gas consumed—a figure not yet touched as an average, by the electric supply, and one which represents from one-half to one-third the actual bare cost to the electricity company of the current supplied to their customers, irrespective of what price they may charge.

The Changing Use of Gas.

[By Mr. Alton D. Adams, in *Sci. Am.*]

Since the introduction of electric lighting, early in the decade 1880-1890, gas has grown less important as an illuminant and its application to heating has greatly increased. This movement in the use of gas is away from a field where it is less efficient than electricity, to one where its heating qualities can be used to greater advantage. An ordinary gas burner consumes about 5 cubic feet of gas per hour and yields a light of approximately 16-candle power. Each cubic foot of this gas burnt develops about 650 heat units, or 3,250 units per hour at the burner of 16-candle power. Incandescent electric lamps of 16 candle power regularly consume energy at the rate of 50 watts each. One watt hour is the equivalent of 3,412 heat units, so that the incandescent lamp of 16-candle power develops 170.6 heat units hourly. It follows that the energy required to maintain the open gas flame for a given illumination is 19 times as great as that necessary in incandescent lamps for equal service.

If the electrical energy required by the incandescent lamp be supplied to a heater, the amount of heat there produced is exactly the same as the amount that would have been developed in the lamp. If the gas required for a given illumination at an open flame be burned in a gas stove, the development of heat there is fully as great as it would be at the burner. Where the gas is perfectly burned and the products are cooled before they escape, the electric heater and the gas stove are equally efficient. In many cases, however, the combustion of the gas is not complete, and even where it is completed the heat is not usually extracted from these products before they escape. In the transformation of electrical energy to heat the efficiency is necessarily exactly 100 per cent., and there are no products of combustion to carry away part of the heat. For the reasons just stated the efficiency of the gas stove may easily drop 75 or even 50 per cent. If the gas stove extracts from the gas passing through it only one-half of the possible amount of heat, the gas is still 9.5 times as effective as a heating as it is as a lighting agent, taking the results attained with electrical energy as unity in each case.

The general tendency is to shift the use of gas to that field where it is under the least disadvantage. This tendency is well illustrated by changes in the number of gas street lamps and of gas stoves used in Massachusetts during the past 14 years. In the accompanying table the number of gas street lamps and of gas stoves operated in each year from 1887 to 1900 are stated as deduced from the reports of the Gas and Electric Light Commissioners of Massachusetts.

Gas Street Lamps and Stoves in Use in Massachusetts.

Year Ending June 30.	Street Lamps.	Gas Stoves.	Gas Stoves in Boston.
1887	18,990	2,378	....
1888	18,335	4,003	....
1889	17,260	6,328	....
1890	15,493	7,418	....
1891	14,107	8,666	....
1892	13,324	10,795	....
1893	12,971	12,880	....
1894	12,700	15,877	....
1895	11,701	42,563	23,881
1896	11,693	72,195	49,610
1897	11,988	78,667	53,350
1898	12,407	79,335	47,698
1899	12,876	87,201	47,635
1900	13,308	95,547	48,064

For the fiscal year of 1887 the number of gas street lamps throughout the State was 18,990, but for 1900, 13 years later, the number of these lamps was only 13,308, a decline of 30 per cent. This decrease in the number of gas street lamps took place in spite of a rapid rise of population during the period under consideration. Figures are not at hand to show the rate of increase for the population of the State since 1887, but from 1890 to 1900 this increase was 25.2 per cent. If the use of gas street lamps had only kept pace with the rise in population, the number of these lamps in 1900 would have been more than 25,000 instead of 13,308. While it is not possible to give the numbers of gas street lamps in years prior to 1887, it seems certain that there was a constant decline during nearly all of the decade from 1880 to 1890. This view is supported by the known increase of electric street lighting during these years. In 1880 the income from electric street lamps in Massachusetts was practically nothing. For the fiscal year of 1890 the value of electric street lighting was $776,986.18, and the sum paid for gas street lighting was only 42.1 per cent. of this amount.

The lowest point reached in the number of gas street lamps was in 1896, when it fell to 11,693. Since that date the increase to 13,308 has hardly done more than maintain a constant ratio to the growing population.

Quite different from the declining use of street lamps has been the application of gas stoves. For the year 1887 the number of such stoves reported was only 2,378, while for 1900 the number was 95,547. That is, during 13 years the number of stoves reported has grown to more than 40 times the original magnitude. In the 7 years from 1887 to 1894 the number of stoves increased to 15,877, the average yearly addition being nearly equal to the original. During the period the reports seem to be incomplete, as figures for various large companies, notably those in Boston, were omitted. Beginning with the fiscal year of 1895 the returns seem to include nearly all important companies, and the number of gas stoves goes up to 42,563, or more than 2½ times the reported number for the previous year. Of the stoves included in the report for 1895, 23,881, or a little more than one-half, were at Boston. Near the close of the fiscal year of 1894 one of the Boston companies, under the spur of competition, offered gas stoves to its customers on very favorable terms. This action no doubt had much to do with the large increase of the number of stoves at Boston in 1895 and 1896. How many stoves were put into use at Boston from 1894 to 1895 cannot be stated, but from 1895 to 1896 the number was 25,729, or more than the entire number there in 1895. During the year just considered, the number of stoves throughout the entire State, including those at Boston, increased from 42,563 to 72,195, or 29,632. It follows that the stoves added throughout the State outside of Boston numbered only 3,903, or less than one-sixth of the increase in that city. In 1896 the severe competition at Boston came to an end, and the maximum number of gas stoves there was reached in the

fiscal year of 1897, when it stood at 53,350. Since the date just named this number has declined, and stood at 48,064 in 1900. At the time of severe competition stoves were installed at Boston without any charge and under contracts that titles should pass to the users when gas to a certain value had been consumed. The small decrease in the number of gas stoves used at Boston is probably due to failures of some consumers to burn enough gas to earn the stoves. Evidently the number of stoves in Boston had been pushed much beyond the normal demand.

Outside of Boston the increase has been constant and rapid, from 22,585 in 1896 to 47,483 in 1900, thus more than doubling in 4 years. This increase is the more instructive because it has come about simply through the natural demand. In 1897 Boston had 67 per cent. of all the gas stoves in the State, but in 1900 this had fallen to 50 per cent. Boston still has four times as many gas stoves per unit of population as the remainder of the State, since its number of inhabitants is only one-fifth of that for the entire State.

An Analysis of the Sixth Detroit Municipal Plant Report.[1]

We have received recently the sixth annual report of the Detroit Public Lighting Commission, and find that it is worthy of more than passing casual attention. Former reports have been previously studied in our columns, and this sixth annual one has a special interest to the electrical community. These reports have always been interesting and valuable in that the detailed analysis of expense which they embody has permitted anyone interested to make all the comparisons and to draw all the conclusions that he could wish. The conclusions which the Commissioners have furnished with their annual accountings have often been challenged; but there has been no doubt about the appreciation of the cold figures which formed the bulk of the publications.

For the usual reasons this report is interesting, but its exceptional interest lies in its showing the first results of the changed policy and the changed control of the celebrated Detroit city lighting plant. In the beginning the Detroit authorities were wise in that they placed their new public lighting system in the hands of a non-partisan commission, who, in turn, selected trained and trustworthy engineers as their executive officers. For over 7 years Detroit, in this respect, set a good example to all other cities. Two years ago there came the inevitable reversion to political methods. The reversion was for a time denied, but its evidences would seem to be indisputable, and finally even the commissioners admitted it, one of them going on record with the statement that it was "all politics in the lighting plant," and that his belief in the desirability of municipal ownership was consequently badly shattered.

It was "Reform" which brought about the establishment of the Detroit public lighting plant. Much of the blame must lie on the local electric light men who failed to understand the public temper of their own city. It is now "Reform" that has put the public lighting plant of Detroit into politics. This report covers the first fiscal year of the second era. That the reform is comprehensive is evident by the fact that the survivors of the former commission resigned almost in a body and so made it possible for the present Mayor to name every one of the 6 members of the Board. In the usual course of events one member is nominated on the 4th of April of each year to serve for 6 years, and a board may contain appointees of several mayors. That the change is effective in the operating force is shown by the fact that not one of the old heads of departments remains in place. New men, appointees of the new board, took charge in April, 1900, and had doubtless familiarized themselves with the system before the beginning of the fiscal year on July 1. Not one of the new men had technical training. The general superintendent, according to his own published statement, had no experience in electric lighting nor in any similar industry before he took charge. Some of his assistants had experience in minor positions, but none of them had held responsibilities comparable to those their new duties entailed. This selection of employees was not accidental. The new president was on record as believing that the plant as previously operated was over officered; that half the "bosses" could be dispensed with, the men be treated more generously, and still 20 per cent. of the payroll be saved. Another of the new commissioners announced, when the competence of the new staff was questioned in the press, that "making electricity is a good deal like making flour—it is all done by machinery."

From a management which proposes to save 20 per cent. of the payroll and which is satisfied that the operation of a public lighting service is merely a matter of machinery, much is to be expected. The new president's published criticisms of his predecessors touched also on the subject of supplies. He had said that "Our purchases have not been made in a businesslike way. We do not avail ourselves of the benefit of competition." With all these openings for the reduction of costs already remarkably low, with a new theory and a new commission and a new force, great expectation would naturally be aroused.

The sixth annual report begins with apologies for a slight increase in the cost of operation for the year, namely, 86 cents per arc light, gross cost, and $2.29 per arc light, cash cost. It attributes this increase to the high prices for labor and supplies, particularly coal, during the year and adds: "It must also be borne in mind that as the age of the plant increases the necessary cost of repairs and replacing of parts, which is added to the cost of operation, must also increase."

The gross cost includes the cash cost, that is to say, the operating and repair expense amounting to $42.59, together with interest at 4 per cent. on the investment, depreciation at 3 per cent., and an allowance for lost taxes, which represents taxes which the city would collect from a private plant performing similar street lighting service. The cash cost of $42.59 is compared with the reported cash cost of $40.30 for the preceding year. The gross cost of $67.31 is compared with the preceding year's gross cost of $66.45.

Fixed Charges.—The lower amount of fixed charges per arc light is due chiefly to the operation of an average of 2,035 lights during the year, as against 1,963 during the preceding year. This increase of service has been obtained by running reserve plant, and, therefore, does not carry with it an increase of the investment. The reduction of fixed charges is due also to some extent to the reduction in the general tax rate of the city during the year reported on, which, of course, reduces the calculated amount of taxes lost. It is notable, however, that while the report announces the installation during the year of a 600-kw. direct connected engine and alternator and a 175-kw. alternator without an engine, and also states that the total investment has been increased from $828,088 to $851,654.83, the figure quoted as the probable assessed value remains unchanged from last year at $351,885. The effect on the total cost of a proportional increase in the valuation would not be great, but the unchanged assessment of the property and the use of the term "probable assessed value" justifies the idea that the estimate of amount of lost taxes is not as reliable as it should be. The valuation should be made by the regular assessors by their regular rules, and "probability" should be eliminated.

Depreciation Charge.—As in all former reports, the commission estimates depreciation at 3 per cent. That this figure is ridiculously low is so well-known to our readers that we will not discuss it again.

The Commissioners have now adopted the policy of substitution of inclosed alternating series arcs for their open arcs. The arc dynamos and lamps displaced by this improvement stand on the books to-day at their cost price of 1,894, less 18 per cent.—that is to say, less 6 yearly depreciation allowances of 3 per cent. The other 82 per cent. of their original price will have to be taken care of in an early balance sheet. This and other changes of the character which have made depreciation such a large item in electric light expenses will soon make the depreciation of the Detroit plant a concrete instead of an abstract proposition.

The construction account is not spread on the record in such detail as is the operating expense. On page 23, however, there are tabulated additional investments amounting to $23,566.83. There is no division between materials and labor. The figures are mystifying when read in connection with the statement already quoted that a new engine and two alternators have been added to the equipment; because the additions to the incandescent plant and steam plant accounts amount to but $930.73, which amount would not pay for the foundations alone of such new apparatus. The heavy item is an addition of $17,073.68 to the investment in cables. This is for cables used to replace overhead pole lines and wires taken down. Against lines and poles there appears an increase of investment of $3,297 80. The depreciation account on the same page contains only the usual 3 per cent. theoretical charge. It does not show anything that would represent the wiping out of the investment in lines and poles, and the entire cost of the cables appears to be considered a betterment. Electric lighting companies, which have been compelled to put their wires underground, and to remove expensive pole lines, will hardly admit that the operation can be carried through without something being charged off from the lines and poles account.

The construction account, to June 30, 1901, stands at $851,654.83. The investment is stated to be $721,861.56. The difference is shown on page 23 to be the 3 per cent. depreciation charged off annually for 6 years. The bonded debt is $650,000, which debt is secured by a lien on the municipality as a whole. The present value of the property is certainly not in excess of the bond issue, although it is doubtless greater than the probable assessed value used in figuring lost taxes. The city should

1. *Electrical World and Engineer.*

take inventory of its property before another annual report is issued. These figures differ too much.

Operating Expense.—To return to the operating expense. The admitted increase of $2.29 per arc over the preceding year, of which coal expense alone was $1.69, means more than is immediately apparent. The increase in the number of lights, which reduced the fixed charge per light, ought to have reduced the operating charges by a definite proportion of general expenses. Moreover, the new commission had economized in the last quarter of the previous year by cutting down its executive expenses to the extent of $1.92 per light. This was an installment of the proposed 20 per cent. reduction of the payroll, and was made up, according to newspaper reports, as follows: The plant formerly had a chief engineer at a salary of $1,500. His duties were assigned to the new city electrician. The offices of secretary and assistant secretary were consolidated, and the new secretary employed at $1,200, as against the $2,700 formerly paid to two men. The positions of outside superintendent and chief lineman, drawing $1,200 and $900, were given to one man at $1,200. Total economy, $3,900 per annum, or $1.92 per light. Some of this saving ought to be credited to the incandescent light department, and some would affect the three last months of the year compared with, but the remainder ought to have extinguished the $1.69 additional for coal.

Operating supplies other than coal cost less than during the preceding year. The largest supply item after coal in such a plant is carbons for the arc lamps. In spite of the increased output the expense for carbons is $184.08 less than during the preceding year. This is accounted for by a lower contract price. Another large item, oil, also shows a decrease of $152.37, which is accounted for in the same way. These reductions of price were not due to any new methods of purchase, but were general throughout the country.

Repair Account.—It is in the maiutenance account that the increased expense appears. Here we find an increase of some $1,200 in wages and $2,500 in supplies. The wages items and the supply items of the maintenance account disagree in a peculiar manner. For instance, there is but a small increase in the wages spent on buildings, and a large increase in supplies. On repairs to steam plants the wages expense is reduced $500, and on electric plant it is practically the same as last year, but the supplies purchased on these two accounts are much in excess. It is understood that this discrepancy is due to charging up bills of outside repair shops as "supplies," though naturally there must be labor items in these bills. The wages account only includes the wages paid directly by the commission.

On lines and cables there is an increase in labor account of about $950, and on arc lamps an increase of $730, with comparatively small expenditures for supplies. This is natural in these departments.

The total figures for maintenance do not bear out the claim that there has been extraordinary expenditure on repairs. The reports show that while in this year the total repair expense is $18,143.74, it was 2 years earlier $17,413.59, and 3 years earlier $16,305.61. In these earlier years the output was considerably less and the expense should be proportionately smaller. The only year in which there is a relatively lower expenditure is the year ending June 30, 1900, in which the maintenance account was kept down to $14,461.12. It may be inferred that the amount expended for repairs in the past year was not far from the average expenditure, and our observations on the Detroit situation indicate that this average expenditure is too little. For instance, the arc lamps and the fixtures on which they are hung—two items the care of which should make up a considerable portion of the proper expenditure of a city lighting plant—are generally, we are informed, in bad condition. The belief of the Commissioners that the Detroit repair account is likely to increase seems to be founded on fact.

It is not certain that even this inadequate expenditure is fully shown. It is an old failing of municipal boards to charge to construction account, when such an account is open, expenses that belong in maintenance. An examination of the list of employees in the maintenance department (page 36) leads to the conclusion that it is not excessively long, particularly when it is noted that the working day is only 8 hours. The annual compensation of these 26 employees foots up $15,732.50; but the total expenditure for the year charged to maintenance account is only $11,288.67. Doubtless the men do not make full time. On the other hand, there must be rush repairs which make overtime. Allowing for these uncertainties there remains a difference of $3,500, or thereabouts, to be explained. Men who ought to know say that this difference covers time of these employees charged to construction, the excuse being that they were actually employed more or less on construction work. This excuse should not stand. If the plant were debarred from making any extensions these employees would necessarily remain on the pay roll and their pay would be charged to operating expense. Such a charge would add about $1.75 per lamp to the maintenance account of the plant.

It appears, then, that the slight increase of the report is the sign of an increase actually quite large. The growing repair expenses of the plant have eaten up the savings made in executive expenses, in carbons, and in oils, and have even required some part of funds meant for construction.

What Constitutes a 2,000-Candle Power Arc Light Per Annum.—So far all our statements of expense have been on the basis of the commission's report, which is in terms of 2,000-candle power arc lights operated for one year. It is now in order to inquire what the commission supplies to the city of Detroit as a 2,000-candle power arc light. Such a light is generally understood to be one absorbing at the lamp terminals about 450 watts and utilizing about 435 watts in the arc. The commission's report—page 9—states that the total output of the plant for the year for arc lighting is 3,475,389 kw. hours. On the same page the average number of 2,000-candle power arc lights is stated to have been 2,035. On page 24 the annual hours of burning are set forth as 3,729 hours 30 minutes. Multiplying the two latter the figures give a result of 7,589,532-arc lamp hours. Using this as a divisor of the output for arc lighting, we find that the average power of the switchboard for each arc lamp is 458 watts.

This will not do. The transmission from the switchboard to the lamps requires considerable power. The system being a series system throughout, it is possible to estimate the power required from the mileage of wire in use. A careful estimate shows that this power lost in transmission is about 9 per cent. of the total. This reduces the 458 watts at the switchboard to 417 watts at each lamp.

Four hundred and seventeen watts per arc means inferior lighting. The lighting of Detroit several years ago in the early days of the plant was noticeably good, the current and the carbons being both what they should be. Observations on two occasions during the year just past, lead to the conclusion that either the current or the carbons, or both, are now inferior. The consumption of carbons in a night's run is less than it should be. The arcs in different lamps differ materially from one another, and, as a rule, are less brilliant than they should be, and we are satisfied that the power does not much exceed the calculated 417 watts. If so, it would obviously be unfair to compare, light for light, the street lighting of Detroit to-day with the street lighting of cities where contractors are compelled, under watchful scrutiny, to give full measure of service.

The reckoning of 2,035 lamps includes some 55 lamps operated in the beautiful Belle Isle Park. It is proper that lights on the paths and avenues of this island should be considered as part of the street lighting system, but inasmuch as they are only operated until midnight—that is to say, half the time of the regular street lighting—it is improper that they should be reckoned at their full value in estimating the number of lamps operated during the year. At least half of this number—say, 27 out of the 55—should be cut off from the figure 2,035 used as a divisor of the annual operating expense, reducing that figure to 2,008 and proportionately increasing the expense per lamp operated.

It appears also from an examination of the statement of arc lamps on page 31, that 26 lamps in buildings and not on the streets are included in the calculation. This includes evidently 7 lamps in the Public Lighting Commission's own building and yard which cannot be considered as forming any part of the street lighting. The Public Lighting Commission in all its reports has included as part of its output the current used in lighting its own station and offices. This is clearly wrong. The lighting of these buildings is an operating expense. To include it as a part of the output in estimates of average cost per arc light is just as absurd as if a contractor should bill to a city the arc lamps he used in his own power house. A further deduction of 7, bringing the average number of arc lamps down to 2,001, is, therefore, necessary.

This same item of light in buildings includes apparently about a dozen or 16 alternating arc lamps supplied from the incandescent system. These are used in lighting the Ferry Dock and other places at Belle Isle. They burn until 11:30 or midnight. If these lamps are to be counted as street lights they should only be considered as half-time lights. But we are informed that the current for these lights is included in the incandescent lighting output of the plant, and the Commission deducts from its total expense before figuring the cost per street light an amount proportionate to the incandescent light output. If we are rightly informed about this, there should be a deduction of these 12 lamps also from the divisor of 2,035. This double credit to the plant is doubtless a mistake and will be corrected in future reports; but the assumption of credit for the lighting of the public lighting buildings is not accidental, and the

reduction necessary on account of half time lights on Belle Isle is indisputable.

In conclusion it appears that the Public Lighting Commission of the city of Detroit furnished not more than 2,001 street lights on the average during the last fiscal year, and that the cost of these was greater by several important charges than shown by the report. The commission, on page 9, reports the total cost of arc lighting for the year as $136,977.22. As we have shown, there should be added to this $3,500 erroneously charged to construction account, and really representing indispensable repairs. To give the Commission the benefit of the doubt and to get the result in round nnmbers, we will say that the cost of arc lighting for the year was $140,070, or $70 per arc light per annum. And this result is only obtained by estimating depreciation at 3 per cent. in a plant which is seven years old, and which has definitely entered on the policy of changing old style electric equipment for new and substituting underground cables for overhead lines.

Evidently the last state of the Detroit public lighting plant is worse than the first. The first year for which we have figures is that ending June 30, 1897. This was also the first year wherein the plant carried its regular load throughout the year. The expenditures for maintenance were reported to be $12.58 per arc lamp. In the succeeding years they fell to $8.48, $8.37, $6.47, and now they have risen again to $7.80. Possibly if there had been a persistent expenditure at the original rate the condition of the property might have been better to-day. It is certain that the cash cost of the first year, namely, $64.19, is much nearer the necessary expense of such a plant than any return made afterwards. There were plenty of disputants who protested that the $89.42 which the commission of 1897 reported as the total cost per arc, was too low, but that figure would be more readily believed to-day than the reported $67.31.

Heat From Electricity.

[From a paper read by Mr. F. O. Blackwell, at the last meeting of the General Electric Engineering Society.]

The object of this paper is to bring out the relative efficiency of the various means of conversion between heat, mechanical power, electricity and light.

The earliest method of turning heat energy into work was the so-called atmospheric engine. It consisted of a boiler and a chamber common to the water and steam. The steam was first admitted to this chamber under pressure, forcing out the water and then, condensing, sucking in more water by creating a vacuum. This same method still survives in the "pulsometer," used by contractors for pumping mud and water from excavations.

The modern steam engine is the invention of James Watt and it has only changed in details up to the present day. The world made more progress in the last century due to steam power than in its whole previous history, and I consider that we owe more to Watt than to any other man that ever lived.

It has been proposed to utilize the heat of the exhaust steam to vaporize a fluid having a lower boiling point than water, such as ether or sulphur dioxide, the ether or other gas being used to operate a second condensing engine. Experiments in this line have not been very successful, the additional complication and cost more than offsetting the theoretical gain in economy.

It is interesting to note how the simplest thing is to come last in the development of an art. The steam jet engine was invented before the Christian era and although it was only a toy it had in it the principles of the steam turbine of which we are now just beginning to appreciate the possibilities. So far as experiments have yet gone, the steam turbine will have the same steam consumption as the reciprocating engine. It would seem, however, as if the steam turbine would eventually use steam more economically than the reciprocating engine. The steam turbine is going to be cheaper in cost, which with the large part played by interest in the cost of power, will be most important.

The gas engine is the only real competitor that steam has had. The gas producer is more expensive, too, than a steam boiler and heretofore the unreliability of gas engines had to be reckoned with. Making proper charges for interest, depreciation, maintenance and repairs it is hard to find any better coal economy in the gas than in the steam engine. With natural gas or dear coal, the gas engine will undoubtedly give the cheaper power.

If we were going to heat hy electricity, we would have to burn 13½ pounds of coal under the boiler in the power house to give the amount of heat that 1 pound would give directly. Looking at it in another way, if coal cost $6 per ton, the equivalent price for electric power would be $4 per horse power per year if used continually. If we assume that electric power for heating can be used to twice the advantage of fuel, we would still have to buy current for $8.60 per horse power per year. I made some comparisons on the cost of heating in Schenectady at present prices and found that electric power would cost 36 times and gas 7 times as much as coal. Welsbach burners greatly increase the efficiency of gas lighting and I imagine have the same efficiency as arc lamps, though I have no figures on which to base this.

The heat in gas lighting is nearly all dissipated at the gas jet, while in electric lighting the heat losses are divided between the power house and the lamps. From this you might expect gas and electric lighting to be equally cheap, but the fact that the first cost and the operating expenses of the electric plant are much higher must not be forgotten.

Danger of Incandescent Electric Lamps.

The London *Lancet* recently called attention to the fact that much popular misunderstanding exists in regard to the heating effect of ordinary incandescent electric lamps. As a result, we often see these lamps in shop windows in close proximity to highly inflammable goods, and in domestic interiors they are not infrequently placed very close to hangings and thin woodwork. As a matter of fact, the incandescent electric lamp does give out a good deal of heat, especially when it is of cheap manufacture. The whole of the energy of the current which the incandescent filament obstructs, and consequently changes into visible radiation, appears as either heat or light; and only 6 per cent. of it is in the form of useful light. While the amount of heat radiated from an incandescent electric lamp is much less than that of a gas flame of equal illuminating power, it is an appreciable quantity, and quite competent in the long run to provoke the ignition of readily inflammable substances in contact with, or in close proximity to it. A proof of the heating power of these lamps can easily be had by plunging them in water. A 16-candle power bulb will boil half a pint of water within an hour. That most dangerous of stuffs, cotton wool, scorches, and eventually bursts into flame, in contact with the lamps; and all forms of thin celluloid, so largely used for toys, will ignite under the same conditions in a few minutes. Sometimes such a burst into flame is attended by explosion of the lamp.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

The title of the Union Oil and Gas Company, of San Francisco, has been changed to that of the United Gas Conrtruction Company, the headquarters remaining as before, in 137 Montgomery street. In fact the change is merely a nominal one. The Company controls the following plants in California: The Watsonville Gas Company; the Corona Gas and Electric Company, and the Hanford Light and Fuel Company.

We are indebted to the New Orleans Lighting Company for a copy of its handsome calender. It is quite up-to-date.

Mr. W. T. Morris has sold his interest in the Gus Light Company of Waverly, N. Y. In the reorganization of its management the following officers were chosen: President, F. T. Page; Treasurer, F. A. Gillette; Secretary, S. L. Gillette; Superintendent, T. A. Gillette.

The Western Gas Construction Company has been awarded a contract for the placing in the works of the Benton Harbor-St. Joseph (Mich.) Gas Company a complete water gas apparatus. The dimension of the set is 5 feet 6 inches.

At the annual meeting of the Syracuse (N. Y.) Gas Company the officers chosen were: Directors, George A. Wood, Jerome L. Cheney, Michael Whelan, Fred. J. Baker and William E. Tanner; President, George A. Wood; Vice-President, Michael Whelan; Treasurer and General Manager, John J. Cummins; Secretary, Jerome L. Cheney. The articles of the Company have been amended, as the report of the election will show, in that the Board now numbers 5 instead of 13.

Mr. W. H. Frost, formerly of Fort Scott, Kas., has been appointed General Manager of the Suburban Gas Company, the promoters of which, as before noted in the Journal, propose to construct and operate a plant for the supply of gas to Delray and other suburban points in the Detroit district.

The special election of the voters of Burlington, Ia., to consider by ballot whether or not a franchise should be granted to the promoters of the Peoples Gas and Electric Company has been postponed to the 18th prox. It was originally set for the 3d prox.

MR. H. C. HUTCHINSON has been appointed superintendent of the electrical division of the Cincinnati (O.) Gas and Electric Company. He succeeds Mr. W. F. White, who had been General Manager for a long time of the Cincinnati Edison Company.

THE South Jersey Gas, Electric and Traction Company has purchased the properties of the Burlington (N. J.) Gas Light Company. This gives the former complete control of the gas supply of New Jersey along the east boundary of the Delaware river between the points of Trenton, on the north, to Camden on the south.

THE Peoples Power Company, of Moline, Ills., has placed a contract with the Western Gas Construction Company, of Fort Wayne, Ind., for the installation of a complete plant on the coal gas lines of the contracting Company. The capacity of the plant is put at 250,000 cubic feet per day, and the outfit is to include an ammonia concentrating apparatus.

THE Oxford City Council has granted the Anniston (Ala.) Gas and Electric Company the right to extend its mains and services to and through that borough. Mr. W. H. Sexton, General Manager of the Anniston Company, avers that Oxford will have a gas service before the summer ends.

MR. FREDERICK COOK, President of the Rochester (N. Y.) Gas and Electric Company, has successfully completed a further purchase of valuable water rights, through the acquiring by title of the Garner property on Brown's race, foot of Commercial street.

MR. A. G. B. HUNT, has been appointed to control the consolidated office work of the Norwich and New London (Conn.) Gas and Electric Companies, and Mr. Alexander J. Campbell will act as General Manager of the concerns. The changes are significant merely from an economical point of view.

THE plant at Geneva, N. Y., was damaged by fire in the severe conflagration which occured in that city about 10 days ago, to an amount not exceeding $1,000.

IN the disastrous fire that happened in Paterson, N. J., early this month the Paterson and Passiac Gas and Electric Company was, as to its office quarters, a severe sufferer. Secretary Rogers, however, was quite up to the situation, for, while the ruins were "smoking hot," he had the headquarters of the Company temporarily transferred to the Edison electric station at Van Houten and Prospect streets. Superintendent Williams, with the other officers of the concern, had a "bad day and night," but the Company is to be congratulated over the part that they played in a disaster the like of which it is hoped will not again be seen in any city.

DURING the year ended December 31, 1901, the volume of gas put out by the municipal lighting plant of Duluth, Minn., was 39,472,200 cubic feet. According to the report of the Superintendent the output for the separate months of the year was as follows:

Month.	Cubic Feet.
January	3,929,700
February	3,351,000
March	3,068,800
April	2,984,200
May	2,507,200
June	2,327,200
July	2,427,000
August	2,761,700
September	3,124,600
October	3,875,000
November	4,502,600
December	4,613,200

IN 1898, the initial year in which the plant was operated in Duluth on municipal account, the output was only 20,002,600 cubic feet; a percentage gain that should be in line with showing that gas is not a back number. If Duluth, however, would be wise in its generation, the city might now take seriously into consideration the reconstruction of its gas plant.

THE proprietors of the Leavenworth (Kas.) Light and Heating Company have placed a contract with the Western Gas Construction Company for the entire reconstruction of their plant. The contract calls for a complete coal gas system of the Western Company's type, from the outlet of the benches to the outlet of the purifiers. The capacity of the plant is put at 250,000 cubic feet per diem, and the plans are arranged for the easy doubling of the output at any time.

MR. ANDREW BROWN, for quite a while in the service of the Equitable Gas and Electric Company, of Utica, N. Y., resigned therefrom recently. Just prior to his departure he was presented by his fellow employees with a handsome watch, chain and charm.

THE authorities in charge of the electric lighting supply of Alameda, Cal., have issued a notice that on the 1st prox., all flat rates will be abrogated, and that thereafter service shall be made on a meter basis. The correspondent who forwarded us this information inclosed the following further statement evidently taken from a local newspaper: "Hitherto flat rate consumers have often let the lights burn all night, riding a free horse to death. Money has been lost on the flat rate and it will be abandoned. At present the amount paid is less than the cost of delivery."

MR. ROBERT W. GETHEN, an old employee of the Philadelphia City Gas Works (he entered its service in 1865), died at his home in Philadelphia the morning of the 12th inst. He was in his 61st year.

THE time or point for the starting of construction work on the plant of the Suburban Gas Company, of Delray, Mich., has been extended from March 31 to July 1.

AT a special meeting of the shareholders of the Consumers Gas Company, of Reading, Pa., it was determined to increase the capital stock from $400,000 to $500,000. It is understood that the money received from the sale of the new shares will be expended in enlarging the plant.

THE voters of Escanaba, Mich., will next month determine by ballot whether or not the gas and electric lighting plants, now operated on municipal account, shall be sold. The municipal scheme at Escanaba, which has been underway for some years, may be safely put down as a rank failure.

A BILL has been introduced in the United States Legislature which has for its object the absorption of the Georgetown (D. C.) Gas Light Company by the Washington (D. C.) Gas Light Company.

MR. GEORGE DANFORTH has secured control of the Independence (Mo.) Gas Light and Coke Company. He will manage the concern hereafter.

THE voters of Fairfield, Ia., will next month pass upon the question of the extension, for a term of 20 years, of the franchise of the Fairfield Gas and Electric Company. The Company agrees to charge the following rates in consideration of the new grant: On illuminating account and use, $1.75; on illuminating and fuel account and use, $1.60; on fuel account, $1.50.

THE proprietors of the Vallejo (Cal.) Gas Company are seemingly satisfied with the way their affairs are going on even though the working for the past year did not show a profit. This state of affairs could be easily remedied if any sort of attention were given to a fair extension of the Company's main system.

MESSRS. BARTLETT, HAYWARD & COMPANY, of Baltimore, Md., have been awarded the contract for the construction of 2 additional holders for the Baltimore Consolidated Gas Company. As we understand it one of the vessels (capacity 3,000,000 cubic feet) is to be erected at the Bayard street station, and the other (capacity 1,000,000 cubic feet), is to be placed at the Canton station.

THE Laclede Gas Light Company, of St. Louis, Mo., has declared its regular dividend on the common stock. The books close on Wednesday, and will be reopened on the 16th prox.

A CORRESPONDENT forwards the following: "Some times ago Mr. Jacob Rogers, for many years the respected Prssident of the Lowell (Mass.) Gas Light Company, put in his resignation as President and Director. The Directors declined to accept the same, hoping that he would reconsider his determination, but in that hope they were balked. Persuasion having failed, the Board was forced to act, with this result. The resignation having been accepted Mr. F. E. Dunbar was elected to the vacancy in the Board, and Mr. George S. Motley was named President and General Manager of the Company, and the vacancy in the Treasurership caused by Mr. Motley's promotion was temporarily filled by the election as Acting Treasurer of George W. Brothers, for many years paymaster of the Company. The Directors also adopted the following resolutions:

"'*Whereas*, after a service of many years as Director, Treasurer and President of the Lowell Gas Light Company, Mr. Jacob Rogers has tendered his resignation as an official of the Company, and having positively declined to accede to the unanimously expressed wishes of his associates to reconsider it, we deem this a proper opportunity to place upon record a respectful tribute of our esteem and appreciation of his services and character; therefore

"'*Resolved*, that in our intercourse with Mr. Rogers, we have ever found him prompt in the discharge of every duty; kind, thoughtful and considerate in the discussion of important questions, courteous and pleasant in personal relations between us, and evincing, throughout his long period in office, a devotion to the interests of this Company seldom equalled;

"'*Resolved*, that this resolution be entered upon the records, and a copy sent to Mr. Rogers.'"

The Market for Gas Securities.

In common with the general share market, which showed pronounced symptoms of weakness since time of last writing, local gas securities went off with the rest. Consolidated shows virtually a loss of one point, whereas it should have naturally and reasonably shown a gain, in that the dividend time was at hand. However, there is no scope for judgment in attempting to unravel the mysteries of the speculative market. The Directors of the Consolidated Company have declared the regular quarterly dividend of 2 per cent., which is payable the 15th prox.

Brooklyn Unionis lower, in sympathy with its near neighbor. We unhesitatingly advise the purchase of that stock at any figure under 225. Consolidated, of Baltimore, continues to gain in value, but Washington (D. C.) gas scored a sharp drop in the week. It is sure to go forward, however, to better figures than those that have heretofore been made, sensational though they were. Peoples, of Chicago, is steady to strong. Some good purchases of this stock for permanent investment have recently been made.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 Wall Street, New York City.

February 24.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	220½	221
Central Union, Bonds, 5's.	3,000,000	1,000	109½	111
Equitable Bonds, 6's	1,000,000	1,000	105	
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	.	108	112
Mutual	3,500,000	100	310	315
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co.. Bonds, 5's	11,000,000	1,000	111	112
Northern Union, Bonds, 5's.	1,250,000	1,000	106	108
New York and East River.. Bonds 1st 5's	3,500,000	1,000	111	115
" 1st Con. 5's	1,500,000	..	109	111
Richmond Co., S. I.	348,650	50	100	..
" Bonds	100,000	1,000	103	
Standard	5,000,000	100	130	135
Preferred	5,000,000	100	150	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	118	..
Yonkers	299,650	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	217	220
" " Bonds (5's)	15 000,000	1,000	119	119½
Bay State	50,000,000	50	⅝	¾
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works..	450,000	100	28	30
" 1st Mtg. 5's	500,000	1,000	93	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	9¼	11
" " Bonds, 5's	5,250,000	1,000	79	80½
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000		
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co..	29,500,000	100	102⅝	103
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	103
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore	11,000,000	100	67⅛	67¾
Mortgage, 6's	3,600,000	..	..	115
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112

Advertisers' Index.

GAS ENGINEERS. Page

Wm. Henry White, New York City ... 287
Fred. Bredel, Milwaukee, Wis ... 274
Geo. R. Rowland, New York City ... 274
The Western Gas Construction Co., Fort Wayne, Ind ... 292
Humphreys & Glasgow, New York City ... 285
David Leavitt Hough, New York City ... 284
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 281
Baxter & Young, Detroit, Mich ... 284
United Gas Improvement Co., Phila., Pa ... 279
James T. Lynn, Detroit, Mich ... 284
A. E. Boardman, Brevard, N. C ... 284
The Jeffrey Manufacturing Co., Columbus, O ... 282

GAS WORKS APPARATUS AND CONSTRUCTION.

Continental Iron Works, Brooklyn, N. Y ... 286
Deily & Fowler, Phila., Pa ... 288
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 284
Stacey Mfg. Co., Cincinnati, Ohio ... 287
Bartlett, Hayward & Co., Baltimore, Md ... 285
Davis and Farnum Mfg. Co., Waltham, Mass ... 284
R. D. Wood & Co., Phila., Pa ... 286
Isbell-Porter Company, New York City ... 286
Fred. Bredel, Milwaukee, Wis ... 274
United Gas Improvement Co., Phila., Pa ... 279
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 281
The Western Gas Construction Co., Fort Wayne, Ind ... 292
Humphreys & Glasgow, New York City ... 285
Logan Iron Works, Brooklyn, N. Y ... 288
Riter-Conley Mfg. Co., Pittsburgh, Pa ... 287
Baxter & Young, Detroit, Mich ... 284
G. Shepard Page's Sons, New York City ... 284
James T. Lynn, Detroit, Mich ... 284
A. E. Boardman, Brevard, N. C ... 284
Christopher Cunningham, Brooklyn, N. Y ... 272
The Jeffrey Manufacturing Co., Columbus, O ... 282
Quintard Iron Works, New York City ... 281
Chas. Creighton & Son, New York City ... 281
The Connersville Blower Company, Connersville, Ind ... 289
Lloyd Construction Co., Detroit, Mich ... 274

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md ... 285
United Gas Improvement Co., Phila., Pa ... 279
Burdett Loomis, Hartford, Conn ... 286
Economical Gas Apparatus Construct'n Co., Toronto, Ont. 281
The Western Gas Construction Co., Fort Wayne, Ind ... 292
Humphreys & Glasgow, New York City ... 285
B. E. Chollar, St. Louis, Mo ... 281

SCRUBBERS AND CONDENSERS.

R. D. Wood & Co., Phila., Pa ... 286
Continental Iron Works, Brooklyn, N. Y ... 286
Logan Iron Works, Brooklyn, N. Y ... 288
Riter-Conley Mfg. Co., Pittsburgh, Pa ... 287
The Western Gas Construction Co., Fort Wayne, Ind ... 292

TAR AND CARBONIC ACID EXTRACTOR.

The Western Gas Construction Co., Fort Wayne, Ind ... 292

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich ... 272
The Western Gas Construction Co., Fort Wayne, Ind ... 292

GAS METERS.

John J. Griffin & Co., Phila., Pa ... 256
American Meter Co., New York and Philadelphia ... 291
Helme & McIlhenny, Phila., Pa ... 291
D. McDonald & Co., Albany, N.Y ... 289
Nathaniel Tufts Meter Co., Boston, Mass ... 290
Maryland Meter and Mfg. Co., Baltimore, Md ... 290
Metric Metal Co., Erie, Pa ... 291
Keystone Meter Co., Royersford, Pa ... 290
Detroit Meter Company, Detroit, Mich ... 291

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia ... 291
John J. Griffin & Co., Phila., Pa ... 256
D. McDonald & Co., Albany, N. Y ... 289
Helme & McIlhenny, Phila., Pa ... 291
Nathaniel Tufts Meter Co., Boston, Mass ... 290
Keystone Meter Co., Royersford, Pa ... 290

GAS AND WATER PIPES.

M. J. Drummond & Co., New York City ... 276
R. D. Wood & Co., Phila., Pa ... 276
Warren Foundry and Machine Co., New York City ... 276
Donaldson Iron Co., Emaus, Pa ... 276
Christopher Cunningham, Brooklyn, N. Y ... 272

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., N. Y. City ... 276

GAS TAPPING MACHINES.

George Light, Dayton, O ... 276
H. Mueller Manufacturing Company, Decatur, Ills ... 272

GAS COALS.

Perkins & Co., New York City ... 282
Westmoreland Coal Co., Phila., Pa ... 283
Berwind-White Coal Mining Co., New York and Phila ... 282

CANNEL COALS.

Perkins & Co., New York City ... 282

CONVEYORS.

The Link-Belt Machinery Co., Chicago, Ills ... 283
The Western Gas Construction Co., Fort Wayne, Ind ... 292
The Jeffrey Manufacturing Co., Columbus, O ... 282

GAS ENRICHERS.

Standard Oil Co., New York City ... 247
The Sun Oil Co., Pittsburgh, Pa ... 283

COKE CRUSHERS.

C. M. Keller, Columbus, Ind ... 283
The Jeffrey Manufacturing Co., Columbus, O ... 282

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, Brooklyn, N. Y ... 276
The Connersville Blower Company, Connersville, Ind ... 289

GAS GAUGES.

The Bristol Co., Waterbury, Conn ... 282

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City 275
Isbell-Porter Co., New York City ... 286
R. D. Wood & Co., Phila., Pa ... 286

CEMENTS.

C. L. Gerould, Galesburg, Ills ... 280

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J ... 280
Adam Weber Sons, New York City ... 280
Laclede Firebrick Mfg. Co., St. Louis, Mo ... 280
Cyrus Borgner, Phila., Pa ... 280
James Gardner, Jr., Co., Pittsburgh, Pa ... 280
Henry Maurer & Son, New York City ... 280
Baltimore Retort and Firebrick Co., Baltimore, Md ... 280
Parker-Russell Mining and Mfg. Co., St. Louis, Mo ... 280
Brooklyn Firebrick Works, Brooklyn, N. Y ... 280
Missouri Firebrick Co., St. Louis, Mo ... 280

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md ... 285
Fred. Bredel, Milwaukee, Wis ... 274
J. H. Gautier & Co., Jersey City, N. J ... 280
Parker-Russell Mining and Mfg. Co., St. Louis, Mo ... 280
Adam Weber Sons, New York City ... 280
Laclede Firebrick Mfg. Co., St. Louis, Mo ... 280
Missouri Firebrick Co., St. Louis, Mo ... 280
S. D. Merton & Co., St. Louis, Mo ... 280

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City ... 286
Continental Iron Works, Brooklyn, N. Y ... 286
Logan Iron Works, Brooklyn, N. Y ... 288
R. D. Wood & Co., Phila., Pa ... 286
The Western Gas Construction Co., Fort Wayne, Ind ... 292

CHIMNEY CONSTRUCTION.

Adam Weber Sons, New York City ... 280

INCANDESCENT GAS LAMPS.

Welsbach Company, Gloucester, N. J ... 278
General Gas Light Company, Kalamazoo, Mich ... 271
D. M. Steward Mfg. Co., Chattanooga, Tenn ... 273

BURNERS.

C. A. Gefrorer, Phila., Pa ... 273
Wm. M. Crane Co., New York City ... 273
D. M. Steward Mfg. Co., Chattanooga, Tenn ... 273

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn ... 273

STREET LAMPS.

Welsbach Street Lighting Co., New York and Phila ... 278
Thos. T. W. Miner, New York City ... 273

PURIFIERS.

R. D. Wood & Co., Phila., Pa ... 286
Stacey Mfg. Co., Cincinnati, O ... 281
The Western Gas Construction Co., Fort Wayne, Ind ... 292

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 275

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y ... 272
R. D. Wood & Co., Phila., Pa ... 286
Continental Iron Works, Brooklyn, N. Y ... 286
The P. H. & F. M. Roots Co., Connersville, Ind ... 289
Isbell-Porter Co., New York City ... 286
The Western Gas Construction Co., Fort Wayne, Ind ... 292
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 284

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind ... 289
Isbell-Porter Company, New York City ... 286
Connelly Iron Sponge and Governor Co., New York City 275
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 284
The Connersville Blower Company, Connersville, Ind ... 289

ELECTRICAL APPARATUS.

Wm. Henry White, New York City ... 287

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City ... 272

PURIFIER SCREENS.

John Cabot, New York City ... 282

GAS STOVES.

American Meter Co., New York and Philadelphia ... 277
Maryland Meter and Manufacturing Co., Baltimore, Md. 290
Keystone Meter Co., Royersford, Pa ... 290
Nathaniel Tufts Meter Co., Boston Mass ... 290

HOT WATER HEATERS.

The Humphrey Mfg. and Plating Co., Kalamazoo, Mich. 271

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y. 274

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md. 285
Continental Iron Works, Brooklyn, N. Y. 286
Deily & Fowler, Philadelphia, Pa. 288
Davis & Farnum Mfg. Co., Waltham, Mass. 284
Kerr Murray Mfg. Co., Fort Wayne, Ind. 284
Stacey Mfg. Co., Cincinnati, Ohio 287
R. D. Wood & Co., Philadelphia, Pa. 286
Logan Iron Works, Brooklyn, N. Y. 288
Riter-Conley Mfg. Co., Pittsburgh, Pa. 287

STORAGE TANKS.

Christopher Cunningham, Brooklyn, N. Y. 272

AUDITORS AND ACCOUNTANTS.

The J. Dobson Good Audit Company, New York City.... 271

INVESTORS.

W. R. Faben Construction Company, Toledo, O. 271

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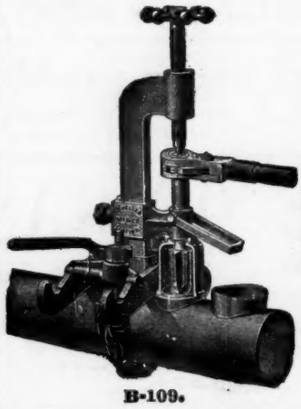

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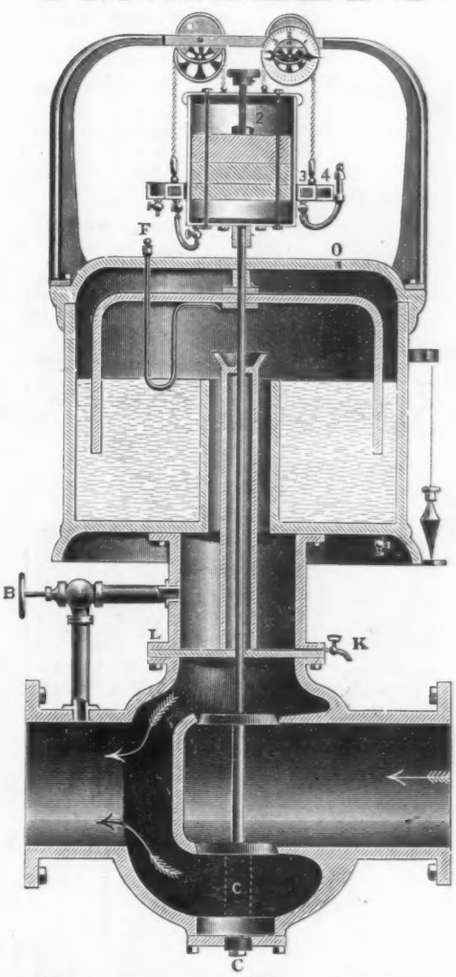

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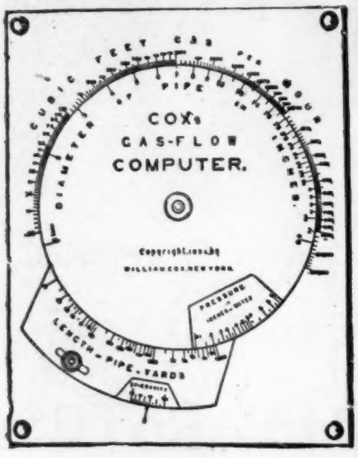

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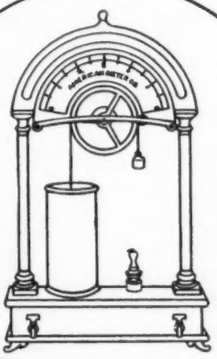

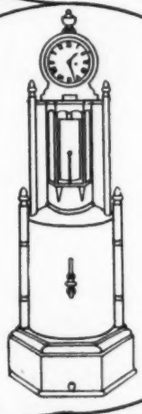

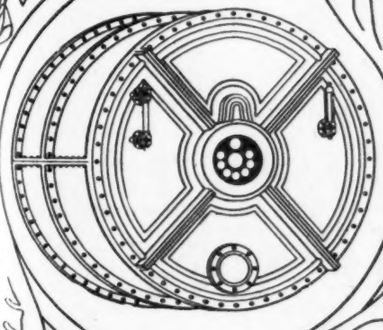

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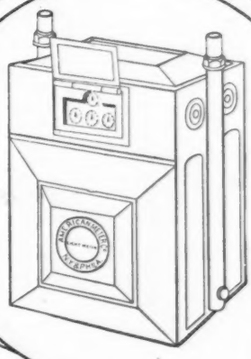
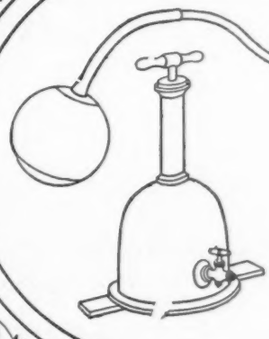
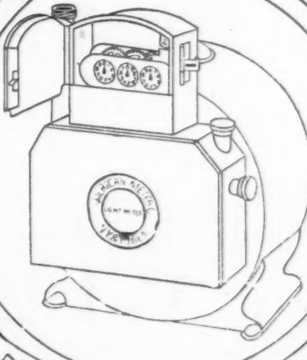






PUBLIC LIGHTING TABLE.

MARCH, 1902.

Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sat.	1	6.20 PM LQ	2.00 AM	5.30	5.45
Sun.	2	6.30	2.50	5.30	5.45
Mon.	3	6.30	3.40	5.30	5.45
Tue.	4	6.30	4.20	5.30	5.45
Wed.	5	6.30	5.00	5.40	5.35
Thu.	6	6.30	5.30	5.40	5.35
Fri.	7	6.30	5.30	5.40	5.35
Sat.	8	6.30	5.30	5.40	5.35
Sun.	9	6.30 NM	5.20	5.40	5.35
Mon.	10	6.30	5.20	5.40	5.35
Tue.	11	6.30	5.20	5.40	5.35
Wed.	12	6.30	5.20	5.50	5.20
Thu.	13	6.30	5.20	5.50	5.20
Fri.	14	10.30	5.20	5.50	5.20
Sat.	15	11.40	5.20	5.50	5.20
Sun.	16	12.30 AM FQ	5.10	5.50	5.20
Mon.	17	1.20	5.10	5.50	5.20
Tue.	18	2.10	5.10	5.50	5.20
Wed.	19	2.50	5.10	6.00	5.10
Thu.	20	3.20	5.10	6.00	5.10
Fri.	21	4.00	5.10	6.00	5.10
Sat.	22	No L.	No L.	6.00	5.10
Sun.	23	No L. FM	No L.	6.00	5.10
Mon.	24	No L.	No L.	6.00	5.10
Tue.	25	6.50 PM	9.00 PM	6.00	5.10
Wed.	26	6.50	10.00	6.10	4.55
Thu.	27	6.50	11.00	6.10	4.55
Fri.	28	6.50	11.50	6.10	4.55
Sat.	29	6.50	12.40 AM	6.10	4.55
Sun.	30	6.50	1.30	6.10	4.55
Mon.	31	6.50 LQ	2.10	6.10	4.55

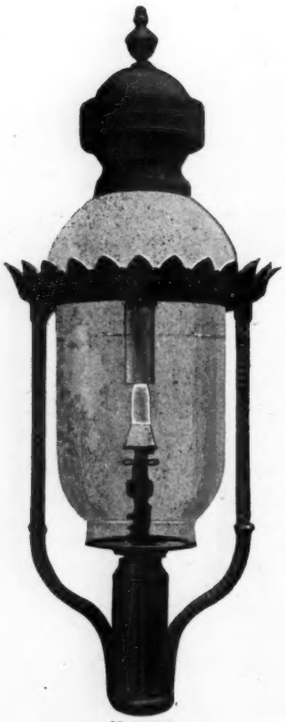
TOTAL HOURS LIGHTING DURING 1902.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	238.30	January	423.20
February	196.20	February	355.25
March	196.20	March	355.35
April	166.40	April	298.50
May	151.40	May	264.50
June	131.10	June	234.25
July	142.40	July	243.45
August	162.00	August	280.25
September	179.00	September	321.15
October	216.30	October	374.30
November	224.10	November	401.40
December	250.00	December	433.45
Total, yr.	2255.00	Total, yr.	3987.45

NEW YORK, 33 Nassau Street. PHILADELPHIA, Broad and Arch Streets. CHICAGO, Foot of Orleans Street. BOSTON, 624 Tremont Building.
CLEVELAND, 809 Cuyahoga Building. ST. LOUIS, 712 Roe Building. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



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Uniformly SUCCESSFUL in 150 Cities and Towns.

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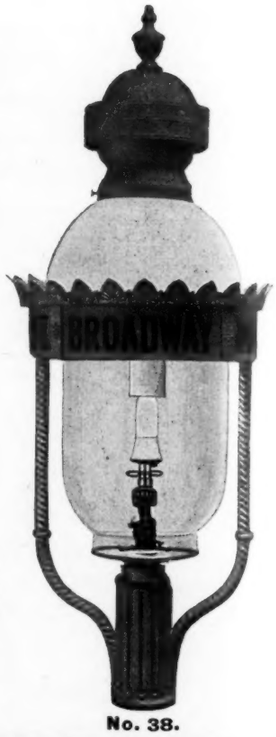
IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others Interested in Municipal and, Outside Lighting.



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The most practical, efficient and artistic burner yet produced. . . . . .

It contains an improved adjustable Bunsen so constructed as to permit of a wide range of variations in gas pressure without blackening the mantles and without an adjustable air shutter. . .

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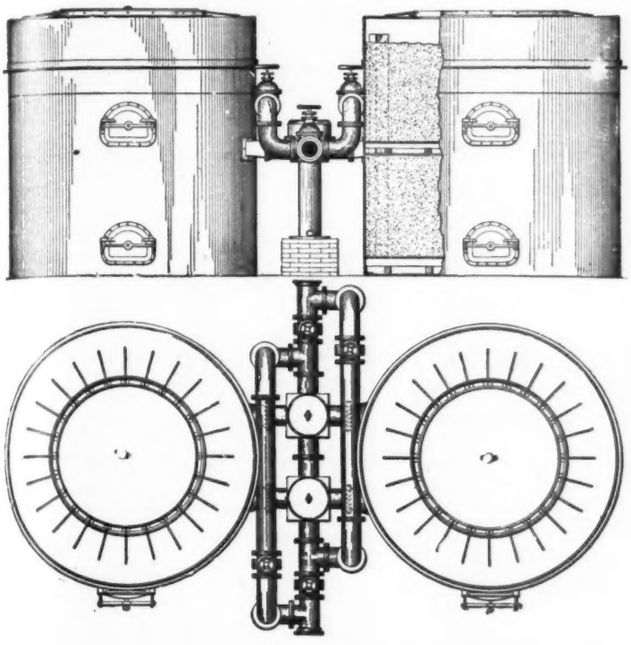

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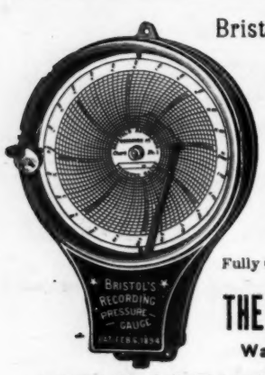

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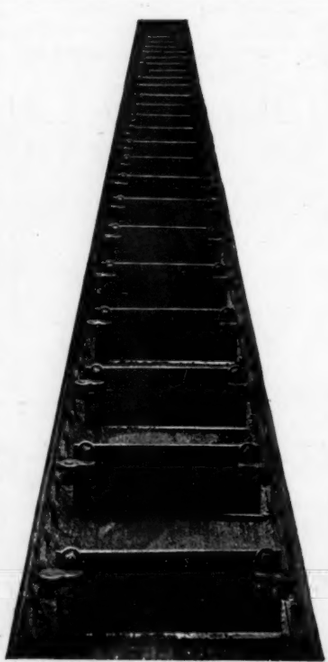
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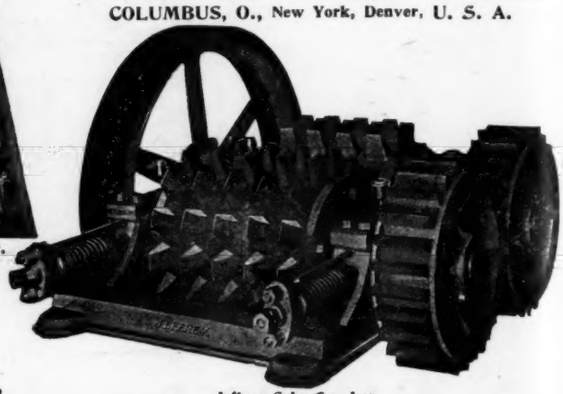
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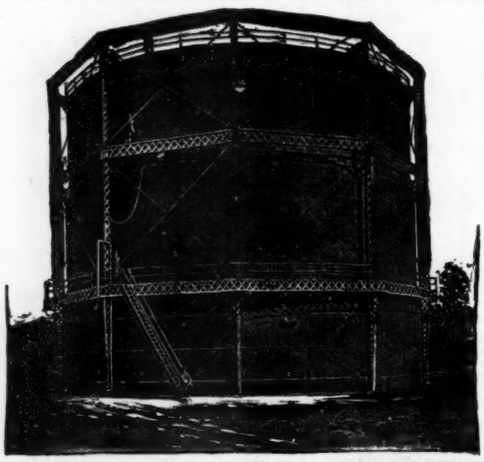

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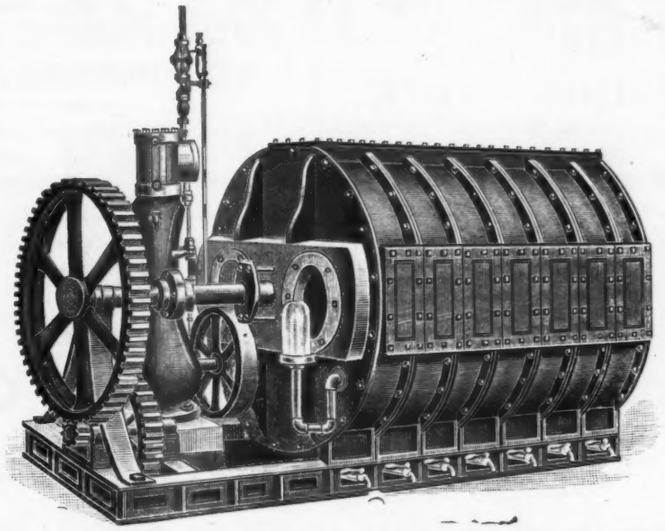

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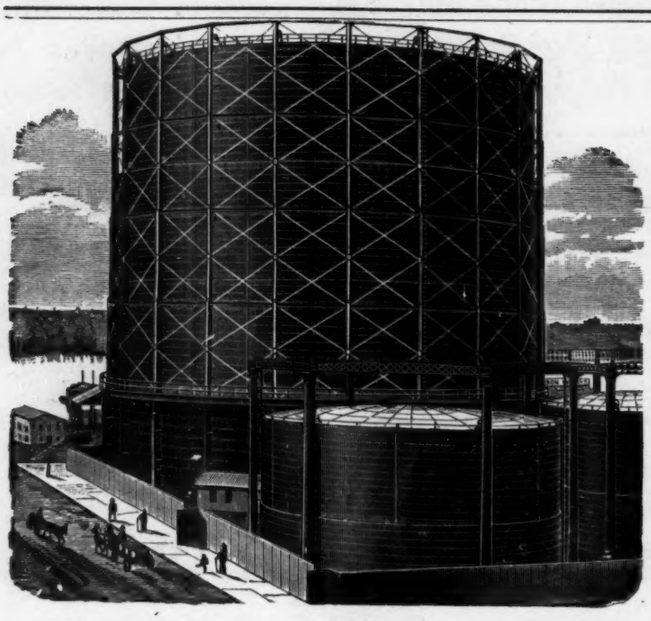

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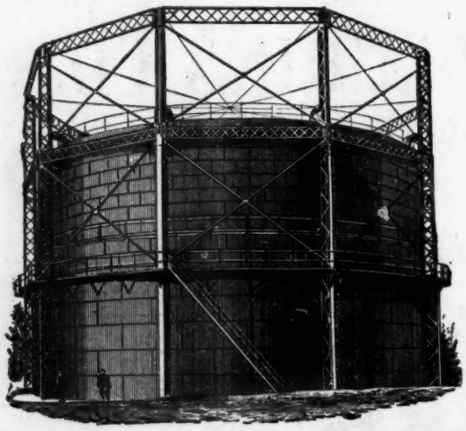

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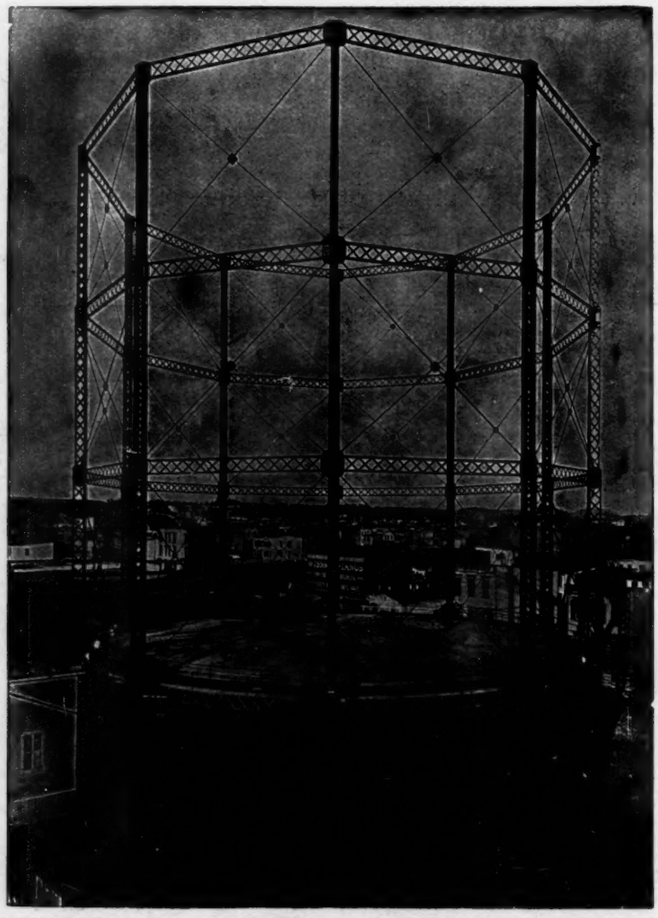

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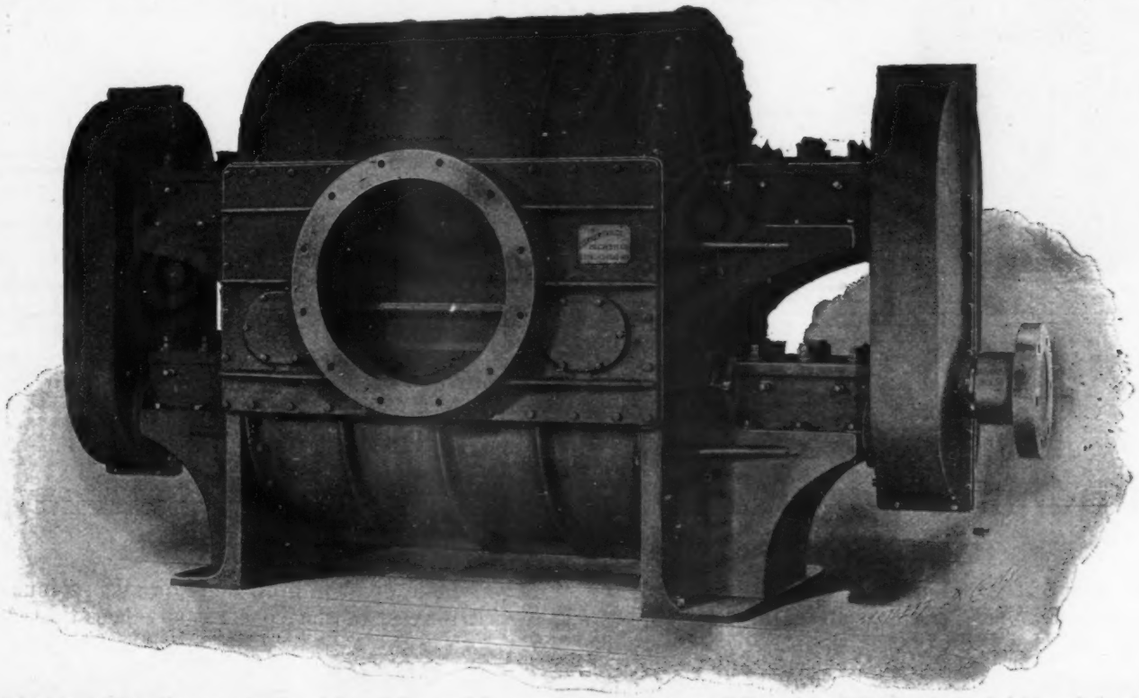

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